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UNRECOGNIZED VERTEBRAL FRACTURE *vs.* KUMMELL'S DISEASE (SYNDROME)¹

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"KUMMELL'S disease," as a diagnosis, is being made by roentgenologists with increasing frequency, much to the consternation of insurers and the confusion of industrial accident boards, often on the unsupported X-ray evidence of a solitary wedge-shaped vertebra and apparently without any clear notion of what Kummell has actually written in so specific a manner about the syndrome he first described.

It was in 1891 that Professor Hermann Kummell, of Hamburg, at the sixty-fourth meeting of the Society of German Biologists and Physicians, at Halle, reported a new symptom-complex which he called "rarefying osteitis of the vertebra." In 1895, in the *Deutsche medizinische Wochenschrift*, No. 11, he made a brief report of this condition, and in 1899 his assistant, Schulz, made an extended one under the title "Traumatic Spondylitis." It was 1921 before Kummell published anything again on the so-called disease which came to bear his name. At this time he reviewed the vicissitudes of his symptom-complex with the caption "Post-traumatic Disease of the Vertebra" (1) and combated the criticisms (annihilating, he called them) of his confrères, protesting that the first description of his symp-

tom-complex still held good and that the cause and the course of the disease were the same as outlined thirty years before.

The cause of the disease is always trauma, Kummell writes, either by direct force against the spinal column or the impaction of a heavy object on the shoulders and neck of the patient. Further results of such an injury are severe pain in the affected portion of the spinal column, of which the patient begins to complain two or three days after the accident. The pain gradually disappears and the patient is able to resume his previous occupation.

After a somewhat longer time, months and often years, severe pains in the spinal column are felt by the patient. Dependent on the position of the injury, there appear also neuralgias in the regions of the various intercostal nerves and slight disturbances of motion in the lower extremities. The gait becomes uncertain, and, if the patient is now examined, one finds, after weeks or months of freedom from symptoms, a definite kyphos and gibbus.

The location of the disease in all Kummell's cases was the thoracic spine, and he notes that the most prominent vertebra, and the adjoining vertebra above and below, were extremely sensitive to pressure, as in the acute stage of tuberculosis of the spine. Also, that when these patients are suspended

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from the head the kyphos usually disappears although the gibbus remains. Since a deep-seated destruction of one or more of the vertebræ has occurred the deformity can no longer be straightened by treatment.

Briefly, he says, we have here a trauma, often insignificant, which affects the spinal column either directly or indirectly, and its immediate manifestation disappears after a few days, only to reappear after months of well-being in the form of a rarefying process of the vertebræ, accompanied by atrophy. In this disease suppuration never occurs, as in the case of tuberculous spondylitis, nor is hypertrophy of the bony mass observed, as in the case of the syphilitic process or newgrowths, and other changes, as in arthritis deformans.

Kummell changed the name of the disease several times because of the doubtful etiology of the condition. The first name chosen by him, "rarefying osteitis of the vertebra," was justified, he believed, because it emphasized the disappearance of the vertebral spongiosa, which takes place gradually after the trauma. The name proposed by Schulz, "traumatic spondylitis," was probably not justified, since the process is not inflammatory but merely traumatic. "Post-traumatic disease of the vertebra" he thought more appropriate, since that is not based on any disputed pathologic process but on the unquestioned cause of the disease—trauma—without which the condition never occurs.

He says:

A fracture or cracking of the vertebra due to trauma can be ruled out, as in the first place the injuring force was in most cases too weak to bring about such a result, and in the second place the temporary pain does not permit the assumption of so severe an injury as fracture of one or more vertebræ. It must, therefore, be assumed that the vertebræ which were affected by the relatively light blow or compression were so disturbed in their nutrition that

an atrophy of adjoining vertebral surfaces resulted, which steadily progressed from the time of injury until the instigation of treatment. This is, therefore, a purely local condition that has nothing in common with a constitutional disease or a neuropathic infection.

Kummell goes to great length to prove that post-traumatic disease of the vertebræ is not a compression fracture, yet in controverting Wullstein, who attacked the disease as a separate entity, Kummell concedes that it occurs as a result of impacted compression fracture but asserts that it also occurs as a result of traumatic influences which cannot often be demonstrated.

He calls to his aid the experimental observations of Lange, of Copenhagen, who took ten thoracic vertebræ from recent autopsies and subjected them to a pressure in a machine such as is used by engineers to test the strength of materials. His results were as follows, quoted by Kummell:

Each vertebra breaks with a certain pressure, but before the break occurs definite changes take place.

Pressure on the vertebra shows no demonstrable changes as long as a certain limit is not exceeded.

If this limit is exceeded, a shortening of each vertebra occurs; the vertebræ are measurably compressed.

If the pressure does not exceed the limit, the shortening disappears after the relapse.

If the pressure exceeds the limit, the deformity does not completely disappear. The compressed vertebræ recover somewhat but never reach their former height.

Besides the amount of pressure, the length of time plays an important part in this permanent shortening. The same pressure which, after short action, is followed by complete restoration, produces an irreversible shortening if the action is prolonged. In this report, the vertebra of the adult acts the same as that of a child; the vertebra of a

healthy man the same as that of a constitutionally weakened individual.

On the basis of his observations, Lange speaks of an osteomalacia traumatica. He explains the traumatic changes in a vertebra and the neck of the femur as due to diminution of the bone caused by the trauma, but without fracture. His interesting experiments prove, says Kummell, that the vertebrae, particularly the lower thoracic and upper lumbar, may be injured by trauma without simultaneous fracture, and that their original shape is recovered, provided the pressure is not too great.

That such processes in the living vertebra are not without consequence is easily understood, Kummell continues, although at first it is not possible to demonstrate the changes by the X-ray. He goes on to say:

It is obvious that a compression of the vertebra such as described above, even though it recovers its former shape, must cause a disorganization of the delicate framework of the bone and produce extravasations of blood in it. A compression fracture or an impacted fracture is, therefore, not necessary to the production of post-traumatic vertebral changes. To effect a gradual disappearance of the bony framework it is sufficient to have a forcible compression of the spongiosa of the vertebra. This is the process as I have first described it and as it doubtless occurs in many cases in addition to those in which definite fracture or fissures of the vertebra are demonstrable.

How there can be disorganization of the delicate framework of the bone and compression of the spongiosa without fracture secondary to external trauma is not clear. What he undoubtedly means is that there is no immediately demonstrable fracture such as one would readily diagnose clinically from compression cord symptoms or by the X-ray. By definition, a fracture is the breaking, either partial or complete, of a solid body by force.

Kummell's disease, so called, is always ac-

companied by a wedge-shaped vertebral body, so that ultimately there is always a shortening of the vertebra, proving, by Lange's own experiments, that pressure on the vertebra must have exceeded the limit so that irreversible shortening has occurred.

It is conceivable that on the first X-ray examination fracture of a vertebral body may not be determined, as may be the case in fracture of the neck of the femur. Even to-day, with the very best X-ray technic, a fracture of the femoral neck may not be immediately demonstrable, one's suspicion being confirmed when, later, absorption of the neck has taken place. Unless the network of the spongiosa has been broken by injury or disease there is no reason to assume that a vertebra will collapse.

The sharply defined symptom-complex of post-traumatic vertebral disease (Kummell's disease), he writes in résumé, comprises three stages:

1. Trauma is a necessary preliminary to the disease, either direct or indirect, by pressure on neck and shoulders or wrenching and crushing of the vertebra such as might be due to the patient jumping from a vehicle. Very often the injury is produced by sitting down with great force and the patient soon forgets the actual injury. The stage of more or less severe shock which follows the injury very quickly disappears in the usual course of events. Local pain in the spine and temporary signs of involvement of the cord are sometimes present.

2. The stage of relative well-being and resumption of the patient's occupation depends, like the duration of the first stage, more or less upon the nature and kind of the injury. Some patients are never wholly free from pain but after the first few days they usually manage to resume their normal occupation, although in a limited way. Others, however, after a few days of discomfort, resume their occupation, often with difficulty and laboriously. Differences in the nature

of the trauma, the extent of the injury, and the resistance of the individual, of course, prevent any hard and fast rules being laid down for this period of well-being.

3. The stage of gibbus formation and the return of local pain in the injured vertebra, the last one which presents a complete picture of post-traumatic vertebral disease, is easily diagnosed clinically as well as by the X-ray.

It is erroneous, Kummell says, to look upon rarefying osteitis as an independent symptom-complex, just as it is erroneous to look upon the compression fracture as a single cause, even in those cases in which the X-ray shows such a process to be present beyond question. The various gradations of the effect of the trauma must be considered as constituting the etiologic factor. Here it would appear Kummell is talking about cause and effect, confusing proximate and approximate, mediate and immediate, in an endeavor to make the etiologic factor something unique.

The pathologic-anatomical support which Kummell adduces is not convincing. He refers to an autopsy specimen described by Ludloff in which the last two lumbar vertebrae were studded with small hematomas, although no fracture was present. The pathologist Ponfick remarked, "This is a case which *almost certainly would have led to a so-called 'Kummell's kyphosis.'*"

A pathologic report by Hattemer in Gärre's clinic is next made use of. A patient, aged 61 years, had fallen on the ice a few years before and almost two years later had had another accident. Pain and disability increased until she was unable to move her extremities. The hospital record reports a definite gibbus of the ninth and tenth thoracic vertebrae, the pathologic diagnosis being "rarefactio vertebarum dosarum et lumbarium. No compression of the vertebrae is observed."

Kummell then proceeds to quote Hatt-

mer's description of what is necessary for the repair of fracture of the vertebra, and why osteitis traumatica occurs in untreated fracture, which is beside the point if Kummell's disease is not fracture.

A case reported by Wiegel is then in order. A man aged 41 years lifted a heavy box and complained of severe pain in the lower portion of the spinal column. He died six months later of an intercurrent disease. On autopsy, a cavity the size of a hazel nut was found in the first lumbar vertebra in which the spongiosa was replaced by a jelly-like substance. "It appears that the patient died," Kummell adds naively, "before a further degeneration of the spongiosa and the formation of a gibbus could take place."

The last pathologic specimen Kummell utilizes is one demonstrated by Rumpel, in 1898, in which the first lumbar vertebra was wedge-shaped and united to the adjoining vertebra by a bony mass, which he said was the result of compression fracture without dislocation.

Of the four autopsy specimens, one was frankly a compression fracture and three might have been any one of several other things.

Pbalthzard, in 1914, in what has been described by Jones (2) as the first complete report of postmortem findings recorded in surgical annals on Kummell's disease, reported a case which resulted in the death of the patient six months after the accident. The necropsy findings showed a marked spinal scoliosis, with a compression fracture of the anterior portion of the body of the eleventh dorsal vertebra. Nevertheless, Jones adds, the exact pathogenesis of this disease is still theoretical.

Kummell said his disease always followed trauma, either by direct force against the spinal column or the impaction of a heavy object on the shoulders and neck of the individual, or by his sitting down with great force or wrenching and crushing the

vertebra by jumping (as from a moving vehicle). It certainly is not meticulous to ask if this description of Kummell's disease does not correspond to the classical description of what is necessary for fracture of the spine, namely, direct or indirect force applied to the spine in hyperflexion or hyperextension or when the longitudinal axis is shortened.

Yet very recently Blaine (3) has written:

The principal feature in the discovery of a case of spondylitis traumatica tarda is the finding roentgenologically of a more or less collapsed vertebral body, often without kyphos or knuckle. It may be incident to an examination for non-traumatic lesions.

Such a finding—"without kyphos or knuckle"—should make one feel rather certain that one is not dealing with Kummell's disease. Blaine continues:

A striking feature of post-traumatic spondylitis tarda is the surprisingly small degree of disability that results in most cases. In fact, if true disability were to occur, I would question whether it were a case of Kummell's disease.

This might be paraphrased thus: A striking feature of fracture of a vertebra without cord involvement is the surprisingly small degree of disability which results in most cases. In fact, if true disability were to occur, I would question whether it were a case of fracture without cord involvement.

Kummell has plainly written that the disability depends upon the nature and kind of injury.

Most writers have grouped recognized vertebral fracture, with or without delayed symptoms, with a description of Kummell's disease.

Fosdick Jones (2), in 1923, reviewed some 106 cases in the literature, including one of his own, under the title "Compres-

sion Fracture of the Spine Developing Delayed Symptoms (Post-traumatic Spondylitis, or Kummell's Disease)." He did not mention a paper by Wallace, of Pittsburgh. As far as I am able to learn it is the largest single contribution of anyone in the literature. Wallace (4) described in detail 82 personal cases of fracture of the spine, some 47 of which were not diagnosed until the appearance of delayed symptoms.

Of the 82 cases of fracture of the spine recorded by Wallace, in 67 a definite history of forcible flexion of the spine was given: 20 cases were promptly recognized, 75 per cent of which showed paralysis; 47 cases were undiagnosed; three cases (6 per cent) had paralysis in some degree. The shortest elapsed time of the undiagnosed cases was 25 days, the longest 1,045 days, the average 311 days. A single body was crushed in 60 cases, more than one in 21 cases; the first lumbar, in 33 cases (or 41 per cent), and the second lumbar in 19 cases (or 23 per cent). The ages ranged from 16 to 65 years, the average being 39. Nearly all of the patients were coal miners.

Kummell recognized that compression of a vertebra may result from indirect as well as direct injury. Yet it is evident that the character of the force is only part of the picture: the character of the body receiving the applied force and its relationship anatomically and physiologically at the time of the trauma come to the foreground.

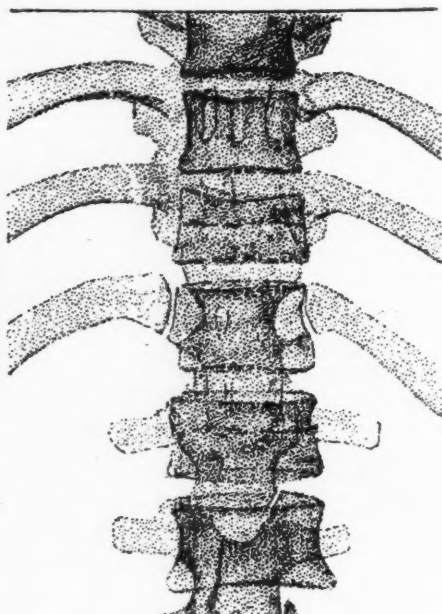
Stern (5) declares the cause of spinal fracture is to be found sometimes in unusual muscle effort, that the most frequent cause of vertebral fracture is indirect violence which gives rise to a hyperflexion or hyperextension of the trunk or to a shortening of the longitudinal axis of the column beyond the limits of its elasticity. When these factors are combined with lateral bending, more or less rotation or tilting of the body of the injured vertebra takes place.

Those of us who have had the experience

of a busy casualty clinic realize how relatively mild trauma, usually indirect, may cause fracture of a vertebra. Cardis, Walker, and Olver (6) report an impressive case of a man, aged 28 years, who, while riding

reached and the bony segments have been crushed by the force. Such fractures usually occur where the spine is least flexible, as in the dorsal region.

Fractures from the compression of hyper-



a



b

Fig. 1. Showing alleged traumatic spondylitis, with horizontal fissures through the middle of several bodies. (From Froelich's "Chirurgie Reparatrice et Orthopedique," after Sinding-Larsen.)

a motorcycle, was struck on the left foot by a car which unexpectedly emerged from a side street on his left. Only the patient's foot was struck; his back was not directly injured and he was not unseated. He was certainly jarred severely but he resumed a twelve-mile journey on his motorcycle. One week after the accident the patient noticed a lump in the small of the back, with associated pain and tenderness. A roentgenogram showed a wedge-shaped collapse of the second lumbar body.

In shortening of the longitudinal axis of the vertebral column, fracture results because the limit of compression has been

flexion or hyperextension are most commonly found in regions where flexible segments join the more rigid portions, as in the dorsal lumbar, dorsal cervical, and cervical occipital regions.

Sever's (7) cases of compression fracture of the vertebrae followed severe violence, usually a crushing force applied through the long axis of the spine or while the spine was flexed. All were diagnosed late. One reason for late diagnosis, given by Hartwell (8), is that the force which causes vertebral fracture is so great that in at least a third of the cases other severe injuries accompany the spinal fracture, and in many instances,

especially where no paralysis is present, these complicating injuries are so apparent that no thought of the possibility of a vertebral fracture enters the examiner's mind at first. If, later, the patient complains of backache his complaints are not sufficiently heeded to cause the physician to examine the back, and the patient is appeased by being told that he "ought to expect a backache after the jolt he got."

A knowledge of the roentgen appearance of the normal vertebra and its physiological cycle of change, as well as the anomalies of birth, is of first importance before one begins to consider the pathologic—a platitude, if you like, but one that needs restatement constantly.

Froelich, of Nancy, in 1920, quoted by Sinding-Larsen (9), described a number of cases of alleged traumatic spondylitis, the radiographs of which (both front and side views in two cases) show the presence of horizontal fissures through the middle of several bodies, with or without deformation of the latter (Fig. 1). According to Froelich, the fissures were due to numerous trabecular fractures.

Hahn (10), in 1922, was the first to recognize the blood vessel origin of the slit-like appearance, often observed on the lateral roentgenogram of the spine of a young individual (Fig. 2). He believed this slit-like appearance represented the X-ray projection of nutrient foramina and was to be observed only during a short period of adolescence, when an increased blood supply was present.

Hanson (11), of Stockholm, has made a detailed study of this problem based on 360 pathologic cases, 40 so-called normal individuals (ranging in age from 6 months to 19 years), and 8 full-term fetuses. He studied the course of the vertebral arteries by injecting Teischmann's substance into the carotid or the aorta of fetal bodies of different ages. By this method he succeeded in demonstrating arteries, even of very fine caliber,

on roentgenograms (Fig. 3), as well as on anatomical preparations. A study of these preparations shows, he says, that the arteries are not concerned with the peculiar vertebral formations described above, their arrangement having been found to be as follows: A small artery, a direct branch of the aorta, passes backwards along each side

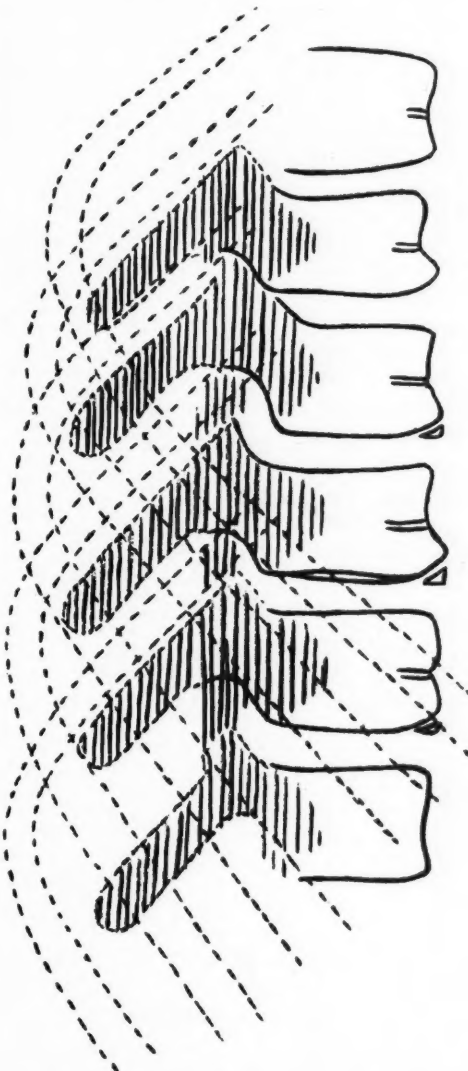


Fig. 2. The slit-like appearance, often observed on the lateral roentgenogram of the spine of a young individual. (After Hahn.)

and close to the middle of the vertebral body, to which, having reached its dorsal aspect, it gives off small branches. Passing

appears on a lateral roentgenogram as divided into three plates, one upper and one lower of denser nature, and one—lighter—



Fig. 3. Showing arterial supply to vertebra. (After Hanson.)

through the intervertebral foramen, small branches are supplied to the arch, while the main branch continues to the posterior aspect of the vertebral body, piercing this near the middle line.

Hanson observed that from late fetal life until the age of two years the vertebral body

between these. In the anterior margin of the latter there is seen to be an excavation in the shape of an amputated cone with its base directed forwards. This excavation is occupied by a vein, running close under the perichondrium and periosteum, respectively, and continuing by a stem on each side of the

middle line towards the foramen vertebrale. The excavation disappears during the second year of life except in the lower fifth, sixth, and seventh dorsal vertebrae, and in the first

view for a fracture line, and it warns against interpreting anomalies of epiphyseal development as compression fractures or disease because they happen to be wedge-shaped.

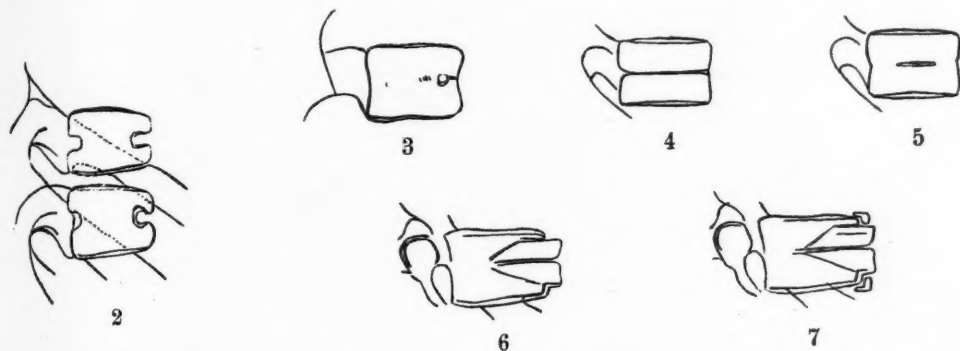


Fig. 4. Showing venous channel and types of vertebral bodies. (After Hanson.)

and second lumbar; where it remains till the age of 14. The canal formations can appear in different forms during the period from two to 14 years, as is shown in Figure 4 (drawings 2, 3, 4, and 5).

In some individuals the vertebral body has a staircase-like outline at its two anterior corners, as shown in the drawing numbered 6. The epiphyses are formed in these staircase-like formations, as shown in the drawing numbered 7. The author (Hanson) has found vertebrae of this kind in individuals with rounded backs, and is assuming that this peculiar shape of the vertebrae may be the anatomical foundation of some cases of kyphosis. He found epiphyses in a child aged 6, though they have previously been stated not to occur before the age of 11. He found the described canal formations in all cases examined—in fetuses 35 centimeters in length and in individuals up to the age of 14. This work of Hanson's, it seems to me, is of outstanding value, since it rules out at once several possible sources of error in the interpretation of roentgenograms of the spine. There is no longer any excuse for mistaking the venous blood vessel as seen in the lateral

If the wedge-shaped vertebra is the result of fracture, it may be asked, why not callus formation, and a return to normal?

The progress of any given case of fracture of the spine is necessarily very slow, as the formation of true callus in the vertebral osseous tissue is very slight in comparison with that formed in the long bone. True union often does not take place, a condition which is most frequently seen in compression fracture of the bodies. Absorption and rarefaction of the bone often takes place. After the erect posture is assumed, a kyphosis slowly develops over the seat of fracture and the injured segment sags forward.

Kolodny (12) has shown that an adequate blood supply to the periosteum is essential for normal union of fractures, and that periosteal callus plays a far more important rôle in the union of fractures than endosteal callus.

Hanson's work, already referred to, has demonstrated the poverty of blood supply to the vertebrae, thus rendering conditions ideal for non-union and consequent collapse of the vertebral bodies. If the injury to the spine has been slight and immobilization and hy-



Fig. 5. Wedge-shaped vertebra as commonly seen in dorsal group (physiological).



Fig. 6. Wedge-shaped vertebra of epiphysitis involving fourth, sixth, and ninth dorsal vertebrae.

perextension employed promptly, a relative return to normal may be expected to occur. Although some degree of compression may remain, there will not be collapse.

If, in addition to the lesions demonstrable by the X-ray, there are present (as Reuter, working in Kalisko's Medical Legal Institute, in Vienna, showed) numerous smaller ones distributed over a wide area, such as fissures of the discs, lacerations of the ligaments, etc., these may later give rise to a condition of chronic ankylosis of the spine.

If Kummell's disease is not fracture, what may it be? Not tuberculous spondylitis; not arthritis deformans; not syphilis, according to Kummell.

It is perfectly evident that every wedge-shaped vertebra, with or without kyphos, is not the result of fracture. If one encounters a wedge-shaped vertebra without a history of trauma or definite evidence pointing to fracture or disease, it will be necessary to

examine the entire spine, for, as Bowman and Goin (13) have pointed out, an extra half vertebra occurs, wedge-shaped in appearance, which is truly an extra segment and is sometimes thought to be a compression fracture.

Then there is the wedge-shaped vertebra so commonly seen in the dorsal group, the result of physiologic change (postural) (Fig. 5), or the erratic development of a congenital anomaly or an osteochondritis or an epiphysitis. The affected vertebra in osteochondritis and epiphysitis (parallel conditions going on at different periods of growth, according to Buchman, 14) may be oblong (a parallelogram) or wedge-shaped, with the base of the wedge anteriorly or posteriorly placed (Fig. 6).

Furthermore, very definite repair processes are evident, which leave the vertebral outlines dense and sclerosed. Multiple vertebrae are often affected. While these patho-



Fig. 7. The patient was a male aged 60, who was struck on the back by a stable door, with no apparent injury. First X-ray examination (Feb. 14, 1924) showed no definite evidence of fracture.



Fig. 8. Same case as shown in Figure 7. Re-examination (March 11, 1924) showed definite X-ray evidence of fractures of the first, third, and fourth lumbar vertebrae.

logic conditions are of the age period of childhood and adolescence their scars are carried over into later life and may well be a source of confusion.

The flattening and wedging may well be the result of minute fractures, if one accepts their origin to be the result of imbalance between the static demand and static capacity.

Calvé, in considering the etiology of osteochondritis and epiphysitis, eliminates tuberculosis, syphilis, Kummell's disease, and congenital malformation. He believes that an infectious origin is the most probable of all etiologic factors. Buchman considers lightly the history of injury usually elicited in these cases, but if the process is an infectious one, with physiologic starvation, injury might well be considered the approximate cause of the vertebral collapse as well as the static imbalance.

Osteo-arthritis of the proliferative type, with wedge-shaped vertebrae and deformi-

ties, mechanically, at least (disregarding its infectious or non-infectious origin), may well represent minute compression fractures consequent to repeated small traumas, impoverishment of blood supply, and bad posture from faulty habits or the demands of certain occupations (Fig. 7).

If one presupposes disease prior to the collapse of a vertebra, as bone cyst or primary or secondary malignancy, the fact still remains that one is dealing with fracture.

I have just seen the X-ray films of a case of Hodgkin's disease primary in the spine, with characteristic wedge-shaped vertebra and kyphos, undiagnosed until general glandular enlargement appeared after two years. If it is any or all of these conditions, it is no longer the specific entity of Kummell's disease.

Kummell plainly states that the largest part of his observations and communications was made at a time when Roentgen's dis-



Fig. 9. Showing the end-result (Feb. 15, 1928) in same case shown in Figures 7 and 8.

covery was as yet unknown, or at least not practically available. He says:

Even to-day [writing in 1921] the number of X-rays which could give help in clearing up causation of the disease is not great. This lies in the nature of the disease, since a patient only rarely has an X-ray taken, shortly after the accident, as the first painful stage is quickly over and a feeling of improvement and relief obtained. No X-ray can be found in the literature which was taken shortly after the trauma and which might be compared with a later picture.

This statement of Kummell's no longer stands. Satisfactory X-ray negatives of the spinal column in the anteroposterior projection as well as lateral have been a development of the last few years. Even in the fifth edition of Köhler's (15) excellent monograph, translated in 1928, speaking of the lumbar vertebræ, one reads:

These are usually viewed in dorsal negatives;

occasionally, too, an oblique negative is helpful, and in children, even a profile negative. Even in the adult, satisfactory profile negatives can often be secured.

With our present X-ray equipment and technical methods one must do a great deal of explaining if he fails to produce satisfactory negatives of the spine in any projection. Improved roentgen technic and diagnosis are the explanation of the infrequency with which one now encounters Kummell's syndrome. Early in the course of the patient's complaint, if not at the time of injury, adequate X-ray studies are now made, which usually reveal the extent of the trauma, and a diagnosis of compression fracture can be promptly made. Appropriate orthopedic treatment, such as hyperextension, instituted early, will prevent complete collapse of the vertebral body in some cases and definitely forestall gibbus formation.

A so-called negative X-ray report should not be accepted wholeheartedly. The term "negative" should be dropped from the nomenclature of the roentgenologist. Figure 8 is a photographic reproduction of a lateral roentgenogram of the lumbar spine of a man, aged 60, who was struck in the back when a barn door came off its hinges. Because of "cupping," seen in the superior articular surface of the third lumbar vertebra, and my particular interest in Kummell's syndrome, this case was followed carefully, and, much to my surprise, on re-examination in less than three weeks the first lumbar vertebra was found to be wedge-shaped, the superior articular surfaces of the third and fourth lumbar vertebræ compressed and pitched forward (Fig. 9). Now, four years later, because of early adequate orthopedic treatment, there is no kyphos or gibbus (Fig. 10). This is the only case I have seen which approximates Kummell's description of the early stage of post-traumatic disease of the vertebra, and yet it was fracture.

In my opinion, based on a rather unusual

series of traumatic spines seen at the Cambridge City Hospital with Dr. Benjamin Godvin and followed roentgenographically over a period of years, what Kummell has described is unrecognized, hence untreated, fracture of the spine—unrecognized because of no cord symptoms, inadequate or no roentgen examination, and the erroneous belief that if one can walk and has suffered only a slight (mild) trauma one cannot have a fracture of the spine.

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ORAL CHOLECYSTOGRAPHY OF TO-DAY¹

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INTERPRETATION of cholecystographic findings is entirely dependent on the technic of conducting the examination and there still exists a lamentable lack of standardization or uniformity in this technical procedure and conduct of the examination. We do not mean to imply that there is only one correct way in which to make the examination, but there are certain all-important fundamentals which must be acknowledged in the management, especially of the "faint" and "no shadow" cases. Our experience has been that the majority of films (75 per cent) submitted here for examination from other laboratories where a cholecystographic examination has been performed and a diagnosis made, are of inferior quality, usually almost black, on which a report of "no shadow" and pathologic gall bladder has been made. The impression is prevalent that a Graham test is a Graham test however performed, and that if a few films result in no gall-bladder outline being discernible, then the gall bladder must consequently be diseased. One of these most important fundamentals is that every "faint" and "no shadow" finding *must be confirmed* by a repeat examination. We have no quarrel with advocates of the intravenous method, as we are confident that the route of administration is only a minor matter and that, *properly* performed, the test will be equally dependable. We do question if the intravenous method is infallible and believe that a "faint" or "no shadow" finding should be confirmed, regardless of the route of administration. Success in cholecystography is in direct proportion to the technical quality of the films; the best interpreter will not be able to diagnose pathologic involvement from mediocre films.

The *method of procedure* which we have found to be most satisfactory in obtaining reliable findings in cholecystography is as follows:

(A) *Preliminary.*—The patient makes an appointment for the examination, at which time a thorough cleaning out is ordered. After this, the preliminary films are made which localize the lower border of the right lobe of the liver and this correct position is marked on the skin of the patient's back. The best exposure technic for this patient is also recorded, so that results may be duplicated. Usually the tube is accurately centered over the right twelfth rib posteriorly, slightly above in obese patients, and sometimes considerably below in thin patients (Fig. 1). If calcified stones are found on these preliminary films, the Graham test adds very little positive information unless differentiation from renal calculi is necessary.

(B) *Details of Oral Administration of the Dye.*—What is the best oral method to use? The two methods which we have found to be most trustworthy are the gelatine capsule in divided doses and the one-dose administration in sarsaparilla. In the capsule method for the average 150-pound patient, eight plain gelatine capsules are loosely filled with the contents of the 3.5 gram ampoule. Two capsules with 5 grains of bicarbonate are given every 15 minutes until all are taken, beginning at 8 P.M. This method is ideal for the private patient and consistently reliable results are obtained. In hospital use the contents of the ampoule may be dissolved in one ounce of water which, in turn, is mixed with a half-glass of sarsaparilla which has been thoroughly stirred until effervescence has been com-

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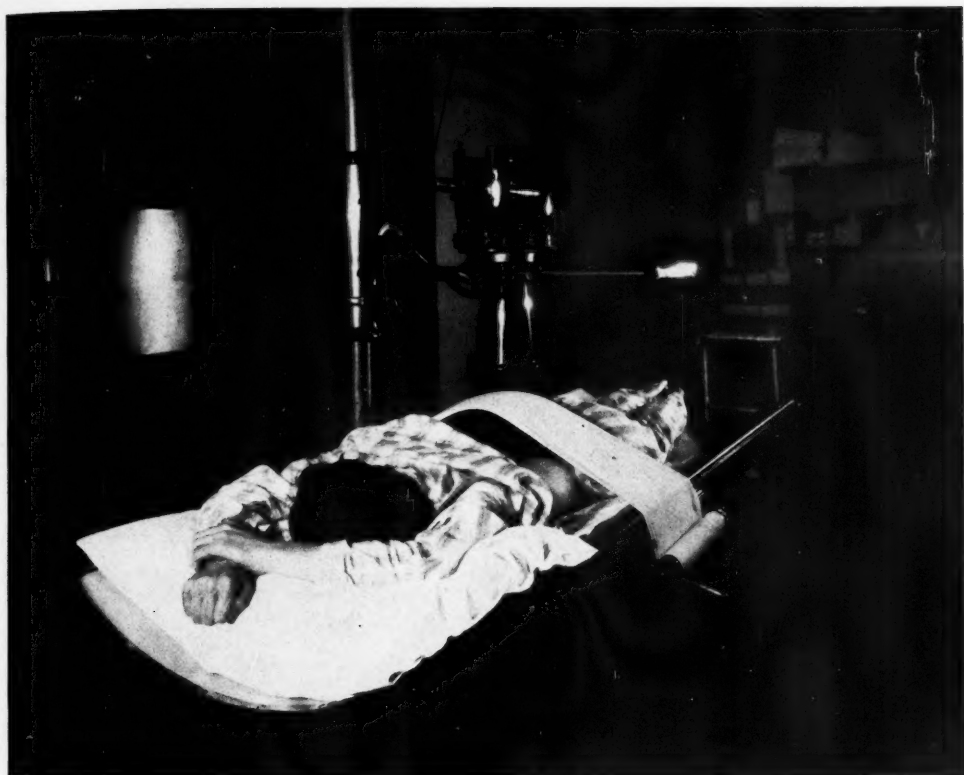


Fig. 1. Position of the patient on the roentgenographic table in making cholecystograms. The patient is comfortable, relaxed, his head is turned to the right side and his toes are over the end of the table. No discomfort from pressure points.

pleted. This makes a coffee-and-cream-colored mixture with an agreeable taste.

In either case the dye is fresh and there is no risk in the administration. We know that it takes the gall bladder at least an hour to empty after a meal, and the dye should be given one or two hours after the regular evening meal so that the gall bladder is receptive to the opaque bile.

(C) *Twelve-hour Examination.*—Twelve hours after the administration of the dye, every effort is made to demonstrate a shadow of the gall bladder. The 16-hour examination is carried out regardless of the 12-hour findings, and the patient is cautioned *not to eat or drink anything but sips of water* in the interim. He is instructed to take

an enema just before returning for the 16-hour examination to clear out the colon contents so that gas and visible particles of the dye will not obscure the gall-bladder shadow. It is an advantage to see the dye in the 12-hour films so that one may be sure it has been taken and not lost by vomiting or diarrhea.

(D) *Further Examinations.*—At the 16-hour examination, if any shadow of the gall bladder can be distinguished, the patient is asked to return for examination *immediately* after eating a meal. Depending on the degree of contraction of the gall bladder at this examination (17-hour), another examination is usually made an hour later (18-hour) to demonstrate maximum con-



Fig. 2-A. An average normal shadow of the gall bladder at the 16-hour examination.



Fig. 2-B. Normal, extreme contractility after a meal, a finding which rules out pathologic involvement. Note the elevation of the gall bladder after a meal.

tractility (Figs. 2-A and 2-B). If the gall bladder empties slowly, a 19-hour examination is made. The final examination is made at 36 hours, early the following morning, and barium is then given to outline the stomach and duodenal cap.

(E) The stomach and duodenal cap are routinely examined after a barium meal following every Graham series, because in a surprisingly large proportion of cases with negative cholecystographic findings, gastric or duodenal ulcer (Fig. 12) or malignancy is found. A few times both a pathologic gall bladder and a gastro-intestinal lesion have been found in the same patient. It is sometimes an advantage to fill the duodenal cap with barium while the gall bladder is distended with opaque bile, as occasionally by this method pericholecystitis and periduodenitis may be diagnosed, although we are

opposed to this as a routine procedure. In thin patients with fairly intense gall-bladder shadows, fluoroscopy may be of value in permitting direct palpation of the gall bladder for localization of tenderness or detection of fixation. In stout individuals or instances of faint shadows, the gall bladder is too indefinite to be recognized with certainty.

(F) *Details of Radiographic Technic that Insure Successful Examinations.*—A tube of 30 ma. has been found most satisfactory for general use, as detail is almost as good as with 10 and much better than with 100 milliamperes. Ten milliamperes may be used in thin patients who co-operate well in holding the breath, especially since faster films and screens are available. One hundred milliamperes are frequently necessary in muscular or obese subjects and cardiac

cases or others who are unable to suspend respiration for a reasonable length of time, and in such cases the quality is sacrificed.

The kilovoltage must be the lowest possible in proportion to the thickness of the body. In a patient whose body is eight inches thick, about 65 K.V. should be used; ten inches, 75 K.V.; twelve inches, 85 kilovolts. This is one of the most important of the technical factors, and in no other way can maximum contrast be obtained and the films have the necessary "snap" and wealth of soft tissue detail.

A film size of 8×10 is the most acceptable, as the area covered is large enough to include the entire right side at the level of the twelfth rib. An excellent gall-bladder outline on an 8×10 film may be easily overlooked on a 14×17 size film. Secondary rays are minimized by using a cone just large enough to cut the corners on an 8×10 film at 25 inches tube-film distance. A 10×12 film is sometimes used to localize the gall bladder.

A Bucky diaphragm is an aid in obtaining maximum contrast. The curved Bucky has given us the best results.

Compression by means of a rubber bladder is a very important means of obtaining the best films. The bladder must be squeezed down as firmly as the patient will permit, thus making the body as thin as possible and also aiding the patient to completely suspend respiration.

In the matter of the patient holding his breath, he must be at rest with feet over the end of the table or legs supported and no unpleasant pressure spots; he must be educated carefully and watched on several trials to insure perfect relaxation and proper suspension of respiration (Fig. 1). It is helpful to have the patient hold his nose closed with his fingers. More films are wasted in obtaining co-operation from the patient in this detail than in any other way. The least motion during exposure will result in fuzziness

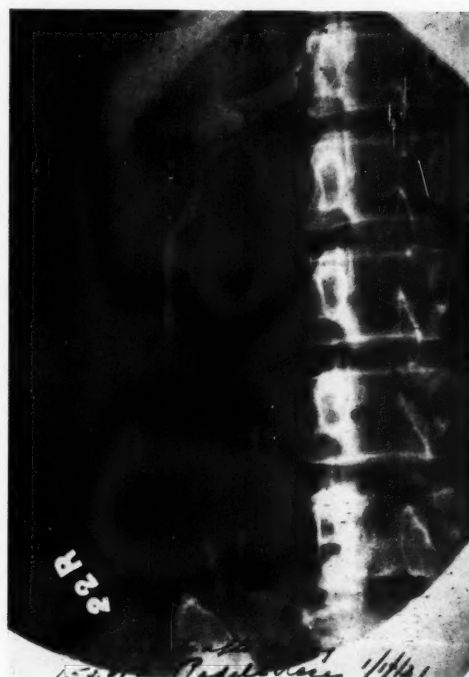


Fig. 2-C. Another example of normal, extreme contraction of the gall bladder after a meal. The ducts as well as the spiral valves of Heister are visible.

and lack of detail and generally poor films. In such, small negative calculi are overlooked and also the faintly outlined gallstones with thin calcified rings. Time and again such shadows are visible on only one or two films of the whole series, because those were of the best technical quality and there had been no motion from breathing (Fig. 3).

STANDARD BY WHICH TO JUDGE WHAT CONSTITUTES A SATISFACTORY CHOLECYSTOGRAPHIC EXAMINATION

(1) In normal cases, preliminary films before the dye is given reveal no gall-bladder shadow; after the tetraiodophenolphthalein the gall-bladder outline becomes more intense from the twelfth to the sixteenth hour; is of normal size, shape, and position and contracts down *markedly* after



Fig. 3. Faintly outlined, thinly calcified, ring-like gallstones, visible on only a few of the best roentgenograms in a series, and which would be missed on any except those of the highest quality. This patient, aged 52 years, complained for two weeks of pain in the gall-bladder region. A tumor was palpable. X-ray examination showed large gallstones and a large gall bladder.

Operation.—Gallstones; cancer of gall bladder, with metastases in liver; pericholecystitis.

Pathology.—Carcinoma of the gall bladder.

a meal, and shows no gallstones. The gall bladder must fill with the dye, concentrate it, greatly contract after a meal, and completely empty.

(2) There must be no blurring or fuzziness of soft tissue or bony outlines from respiration or movement.

(3) Bony detail in the lower ribs and vertebral bodies must be sharp-cut and distinct.

(4) Soft tissue outlines must be distinct. The entire border of the right lobe of the liver should be visible, which insures correct position and rules out situs inversus. The right kidney outline is always distinctly

visible, as well as the edge of the psoas muscle.

(5) The dye should be visible in the intestines unless an enema has been given. It is an advantage to be able to see the tetraiodophenolphthalein at the 12-hour examination as that proves the patient took the dye and retained it (did not lose it by vomiting or diarrhea).

(6) The area included on the films is from the right tenth rib to the hip joint. In "no shadow" cases, examine the spine closely as a gall-bladder outline may be hidden by the vertebral bodies, and the patient must be rotated in order to demonstrate the viscus.

(7) There should be maximum contrast—no gray-brown tints—yet the films must not be too dark. These are the two most frequent offenses. The first is caused by too high kilovoltage, the second by overexposure, which is often combined with under-development. Detail is consequently of poor quality, and slight shadows of pathology may be overlooked. Any film which is so dense that an unusually intense light is necessary in order to see through it is unsatisfactory, and should be discarded.

(8) Make enough films. A "no shadow" or "faint shadow" diagnosis on two or three films is the cause of most failures; or worse yet, the films available may be too dense. Such cases should be re-examined.

Concerning an important modification of the Graham test to permit more detailed study of the *contracted* gall bladder, it is of great consequence to examine the gall bladder after a meal, not only to demonstrate a strictly normal cholecystographic response but also to be certain that no small gallstones are being missed. The statement has been made that if a gall bladder fills with the dye, it can empty, which, of course, is obvious. But to claim that *therefore* no observation is necessary after a meal is to chance overlooking small calculi which are

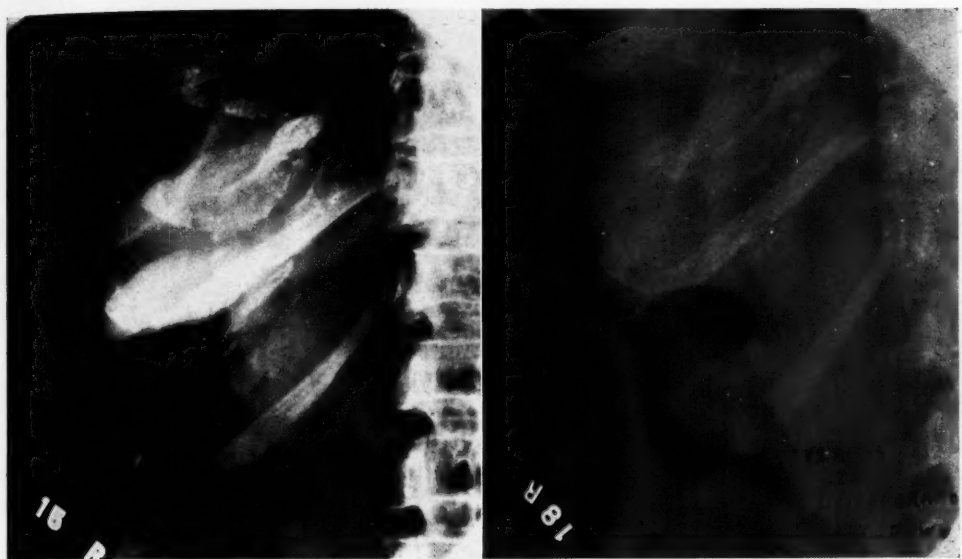


Fig. 4. Pericholecystitis. Cannot demonstrate normal contractility of the gall bladder after a meal; gall bladder fades away. The patient had pain in the epigastrium, radiating posteriorly and to the right. There had been recurrent attacks for 25 years, more severe of late. These attacks lasted about 24 hours and occurred every five or six weeks. The patient was never jaundiced; the abdomen was flaccid; there was tenderness on deep pressure over the gall bladder.

X-ray Examination.—Apparently normal cholecystographic response except that normal contractility after a meal could not be demonstrated.

Operation.—Gall bladder was slightly thickened; no stones; very dense adhesions between gall bladder, duodenum, and omentum.

frequently visible only in the greatly *contracted* gall bladder and after some of the dye has been evacuated. Deformity from adhesions is often brought to light as the gall bladder empties, and Kirklin (1) has shown the necessity of watching the gall bladder empty in the detection of small polypoid tumors. The usual method of making an examination an hour or so after the patient has taken food was found to be unsatisfactory, as frequently the gall bladder had already emptied and no shadow was distinguishable. We then began to make examinations immediately after the meal, following up with more frequent observations while the gall bladder still contained opaque dye. We found that one of the important characteristics of normal function in the gall bladder is *contraction after a meal to one-fourth its former size or even smaller than when*

fully distended, and the demonstration of this is of importance in ruling out pathologic involvement. Such evidence of normal function was found to be present in about one-third of the cases in which a shadow was obtained, and is more pronounced and easier to observe the more intense the gall-bladder shadow. On the few gall bladders found at operation to be pathologic but reported as negative after a Graham test (so-called false negative), we have never been able to demonstrate this maximum contractility after a meal. We believe that when it can be demonstrated, pathology can be safely ruled out. In such a viscus the muscular coats cannot be seriously infiltrated, and the extremely small size of the contracted gall bladder positively negates the presence of any gallstones. Such a finding of a greatly contracted but still

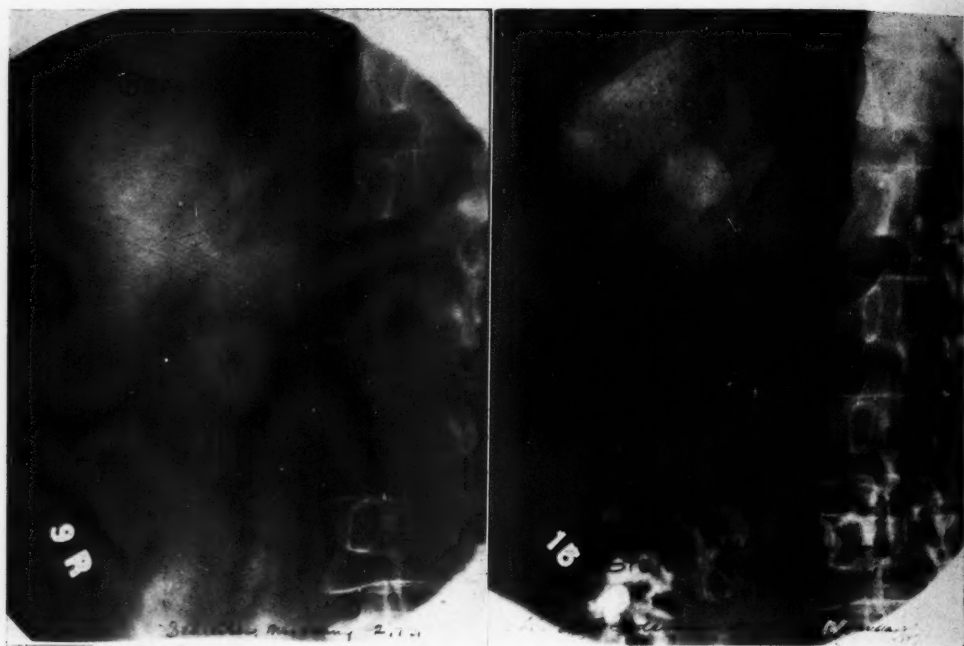


Fig. 5. Type of gallstone demonstrated after dye "coats" it. The patient, 51 years old, complained of attacks of pain in the upper abdomen twice a week for nine months. There was jaundice during several attacks.

X-ray Examination.—No gallstones in preliminary films. After dye, a generally contracted gall bladder, with poor function, was seen. Chronic cholecystitis.

Operation.—Thick, small gall bladder with narrow, thin cystic duct containing a large, round, somewhat roughened, dark brown, solitary calculus, the size of a large marble.

plainly visible gall bladder has never been present in our experience when dense pericholecystic adhesions were found at operation (Fig. 4). In cases of faint shadow there is often sluggish contraction or none at all demonstrable, the gall bladder fading away soon after the meal, due to disease of the wall or the presence of stones. Occasionally, small stones which were hidden by the dense shadow of the distended gall bladder may be recognized after the gall bladder has contracted.

CHOLELITHIASIS

As stated on many occasions, gallstones are roentgenographically of two varieties, opaque and non-opaque. The opaque stones usually contain a varying percentage of cal-

cium and can be detected in the preliminary examination. This finding is many times sufficient for surgical indications, without the use of the Graham test. The visualization of the gall bladder, in addition, often brings to light many interesting details as to the condition of its wall, obstruction of the cystic duct, etc. But far more valuable than all is the state of the function of the gall bladder. It is surprising to see how often we have stones present in a gall bladder which has a fairly normal sequence. This in itself is extremely valuable as to the immediate surgical indication, for we are of the opinion that, given a case of opaque gallstones, we may be sure that there is considerable pathologic change in the gall-bladder wall and that removal is indicated. We have seen too many patients with known



Fig. 6. Visualization of the common duct at the 16-hour examination when it contains the dye. The gall bladder had been removed eighteen years previously. The pointed distal end of the duct where it passes into the intestinal wall is distinguishable.

chronic cholecystitis, with stones, postpone removal until an acute attack, with gangrene, carries them off.

The non-opaque stones are composed mostly of cholesterol or bile salts and have insufficient calcium content to be visible roentgenographically unless the dye has been given. If the gall-bladder shadow is obtained, the stone or stones appear as single or multiple sharp-cut, circular or squared dark spots within the white gall-bladder shadow. Opaque bile surrounds the non-opaque stone and visualizes it by contrast of shadow. A single large or small stone of this variety is usually seen in the fundus and can be made to move around by shifting the position of the patient, or at times simply contractions of the gall-bladder wall during emptying will change the location of the stone. Small polypoid tumors may be mistaken for calculi of this character. They



Fig. 7. "Faint" shadow of gall bladder, "strawberry" type. The patient was a boy 14 years of age, who complained of pain, with nausea and vomiting, for a year. There were slight rigidity and spasm in the right upper quadrant; direct tenderness over the gall bladder.

Operation revealed a gall bladder of double normal size; tense, with thickened wall; numerous adhesions to duodenum.

are usually seen near the edge of the gall-bladder shadow, however, and never change their position (Kirklin, 1).

At times it is difficult to differentiate the shadow of a large non-opaque gallstone from a bubble of gas in the colon. No single recent suggestion is of as much importance as the routine use of colonic cleansing between the twelfth and sixteenth hours after the dye. It clears out the gas and gives one an opportunity to make correct interpretation. Bubbles of gas in the descending arm of the duodenum are deceiving and may be mistaken for stones. Careful comparison of the entire series of films will usually clear up this differentiation as the mottled shadow of a gall bladder partially or completely



Fig. 8. Example of a "faint" gall-bladder shadow containing non-calcified gallstones. There are two huge stones in the neck of the very large gall bladder, resembling gas in the pyloric region and duodenal bulb; also many small stones in the fundus. The patient, 53 years of age, had had attacks of jaundice for the last two years; no pain. Operation revealed cholelithiasis and cholecystitis.

filled with stones has a fairly constant appearance. If no gall-bladder shadow is obtained because the cystic duct is obstructed and the dye cannot enter the gall bladder, these stones cannot be recognized and the examination is reported as a "no shadow" case. It is well for the roentgenologist to appreciate that in fully 60 per cent of these patients stones are present, although he may not be able to demonstrate their presence. In reporting these cases, always state the above facts, otherwise one may be held responsible for not reporting stones found at operation.

As we have previously reported, we have had a number of cases of fairly large non-opaque stones located in the cystic duct which could not be recognized until a small

amount of the dye-impregnated bile worked its way around the stone and coated it sufficiently to render it visible (Fig. 5). Some of our colleagues have become so enthusiastic in producing a dense shadow at full concentration that they overlook the fact that small non-opaque stones can be overshadowed. If preliminary films are made before the dye is given, most opaque stones can be picked up; it is a safe rule, however, to examine both before and after the test as well as during the filling and emptying of the gall bladder.

Dr. Phemister, Dr. Rewbridge, and Dr. Rudisill, at the American Medical Association meeting held in Philadelphia in June, 1931, called attention to the very interesting fact that in obstruction of the cystic duct with cholesterol or bile pigment gallstones, large amounts of calcium carbonate may be deposited in the gall bladder or in the gall-bladder wall. In some instances there is a cast of calcium carbonate occupying the entire gall bladder. If the gall-bladder wall can assume such strange activity, one questions if it is not possible that in some cases a chemical change occurs in the dye-impregnated bile whereby there is a breaking up of the iodine content and destruction of the shadow-casting element. If this is so, it may account for some of our "no shadow" cases. Investigation along these lines is now under way.

PERSISTENCY OF THE SHADOW

In some cases the gall bladder fails to respond to the stimulus of food and does not contract and empty as it should. It is usually fairly reliable evidence of a deficiency in the muscular tone of the gall bladder. One sees "persistency of shadow" as a part of a general condition of asthenia, and it is often noted in cases showing marked 6-hour gastric retention after the barium. When the shadow disappears after food and again faintly appears 36 hours after administra-

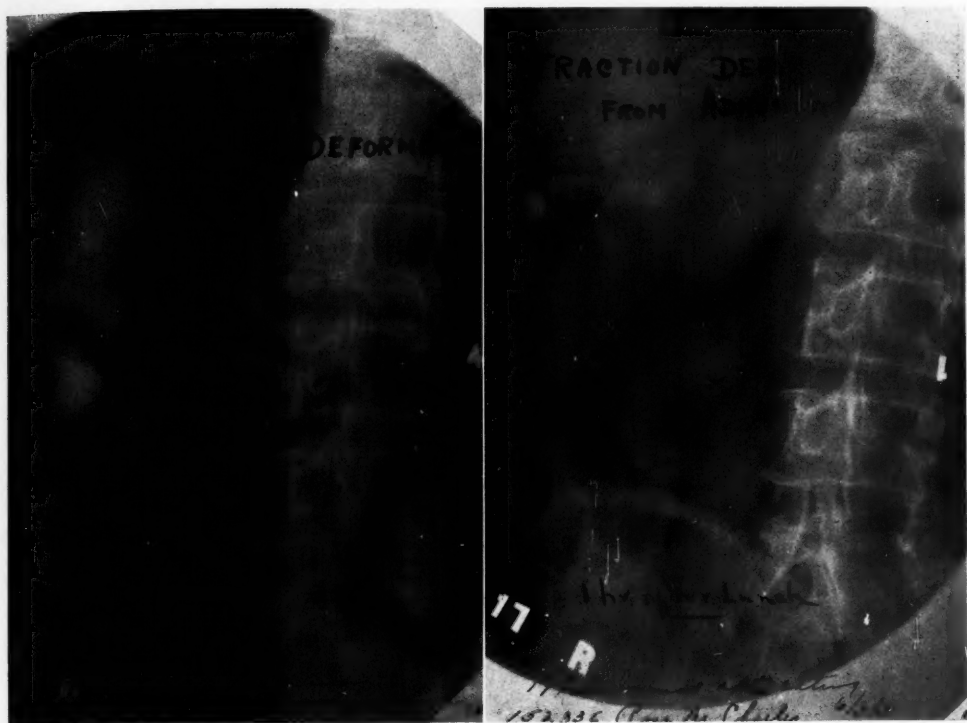


Fig. 9. Example of traction deformity from adhesions. The patient, 74 years of age, complained of attacks of pain in the gall-bladder region, sometimes lasting two weeks, with nausea and vomiting. "Gas" present; bowels regular; no jaundice.

X-ray examination revealed deformity and displacement of the gall bladder, with fixation from adhesions.

tion of the dye, it usually indicates reabsorption, and up to date we have disregarded the finding as of no importance.

Now and then a case will show what we call a "late appearance." It is rare, but in all of our series the gall bladder has proven to be pathologic.

VISUALIZATION OF THE DUCTS

The ducts are outlined commonly in contracted gall bladders after the meal. Even the spiral valves of Heister in the cystic duct are plainly distinguishable in favorable cases (Fig. 2-C). If a sufficient number of observations are made during the emptying of the gall bladder, one may be able to de-

tect pathology of the ducts. In one case we were able to visualize the common duct eighteen years after cholecystectomy—it showed a distinct narrowing at the ampulla of Vater (Fig. 6). In another patient we detected a non-opaque stone located in a dilated common duct, the gall bladder having been removed some years before.

FAINT SHADOW

What is a "faint shadow" and how can it be recognized? One knows that following the oral administration of tetraiodophenolphthalein the gall bladder slowly fills with the opaque bile, reaching full distention



Fig. 10. Angulation of the gall bladder, with adhesions. The patient, 49 years old, had had attacks of severe pain in the gall-bladder region for the first time six years before examination and again two weeks before. Slightly jaundiced; no vomiting. X-ray examination showed a kinked, angulated, deformed gall bladder which functioned poorly; no gallstones.

in about twelve hours; that one of its main functions is to absorb some of the liquid portion of the bile, leaving the remainder much stronger in its solid constituents. This concentration occurs about sixteen or seventeen hours after giving the dye. The normal shadow at this observation is smaller and much more dense than that seen at the twelfth hour and is the shadow that one establishes as the "standard." From this known density one can recognize variations. There are, of course, shadows which are not so dense as the "standard" and still are within normal limits; these are sometimes difficult to evaluate but long experience will render the distinction recognizable. In our early studies we made comparison between the shadows of surgically proven pathologic gall bladders and the standard, and soon established a density which we felt



Fig. 11. Clinical diagnosis was acute cholecystitis. The gall bladder functioned normally after the Graham test. A barium clyster demonstrates a high cecum which has never descended. The patient has had pain in the right side for the past three weeks, with moderate fever; vomited once; tenderness in right upper quadrant. Clinical opinion was gall-bladder trouble.

X-ray Examination.—Negative Graham test. High, non-rotated cecum (tender); appendix not outlined.

Operation revealed appendiceal abscess under the liver.

we could definitely state to be a "faint shadow" (Fig. 7). The ability to recognize this finding can be perfected by a close comparison of the normal with the density of those gall-bladder shadows known by the presence of visible gallstones (Fig. 8) to be pathologic. One must bear in mind in this interpretation that technical factors may vary within wide limits, and two examinations on the same case may result in somewhat different findings. Considerable depends on whether or not the fasting period has been broken; whether there has been vomiting or diarrhea, and, finally, on whether or not the dye is visible in the 12-hour

films. We are often compelled to refuse to attempt a diagnosis on only a single examination which has resulted in a "faint shadow," unless there are stones, jaundice, or some other acceptable cause accompanying this finding. The safe rule is to make a re-examination in any suspicious case, as more will be learned by repeating the test than in any other manner.

What does a "faint shadow" indicate? If we assume that opaque bile enters the gall bladder, then a "faint shadow" must indicate one of three things:

(1) That the gall-bladder wall is so thickened from an old chronic inflammation that the density of the shadow of the dye-impregnated bile is lessened (Fig. 7).

(2) That the gall bladder is so packed with stones as to allow only a small amount of the opaque dye to enter. This is a very frequent finding in chronic cholecystitis with stones (Fig. 8).

(3) By far the greatest number of faint shadows result from some interference with the normal function of concentration. This is especially true in acute cholecystitis or an acute exacerbation in an old chronic case. This loss of function is due to the crippled condition of the mucous membrane because of inflammatory changes, which may be of varying degree, so that our shadow often passes all the way from faint to none at all. Bronner and Schüller (2) believe that on account of the inflamed membrane in acute cases this finding is due to increased ability of the gall-bladder wall to absorb "contrast bile." We have never been able to recognize this occurrence and have had the feeling that events in the gall bladder follow the same routine as in other mucous membranes throughout the body, namely, in the presence of an acute inflammation there is considerable edema and that edema in tissue decreases rather than increases absorption. Their contention, however, is supported to a considerable extent by Iwanaga (3), who



Fig. 12. Clinical diagnosis was acute cholecystitis; roentgen findings demonstrated normal cholecystographic response and duodenal ulcer. The patient, 45 years old, had had pressure pain for the past year in the epigastrium, radiating to the right upper quadrant and back; nausea; no vomiting; anorexia.

X-ray Examination.—Normal gall bladder by Graham test. Marked and persistent deformity of the duodenal bulb from ulcer.

has called attention in his animal experiments to the fact that traumatic or bacterial inflammation of the gall bladder gives rise to increased absorption of the bile. Rosenthal and Licht (4) seem to be of the same opinion, they having expressed themselves as convinced that there is an increased absorption of bile acids in acutely inflamed gall bladders.

We must not fail to recognize that there are many cases of old sclerotic gall bladders, in which the function of concentration is defective, resulting in a faint shadow.

That we may have a varying degree of inflammatory change from normal to badly damaged mucous membrane in the same gall bladder is conceded, but we do not believe that this will influence the character of the general shadow. Kirklin, Caylor, and Boll-

man (5) have found that concentration in the gall bladder is the sum of the activity of the entire organ, and that diseased portions may be found in a gall bladder without noticeably influencing the concentrating power of the organ as a whole.

cases, but the authors firmly believe that when a "no shadow" finding is obtained and verified, it means that the cystic duct is obstructed, provided, of course, that the bile is opaque to the X-ray. If it is not opaque, there is interference with the normal func-

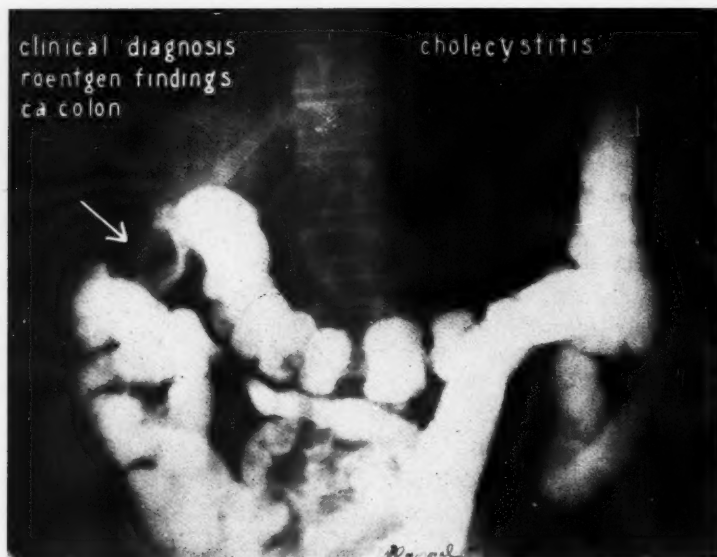


Fig. 13. Cancer of the colon mistaken for cholecystitis. The patient, 56 years old, complains of cramp-like pains in the right upper quadrant, which have been present for four months. He has lost fifteen pounds in weight during the past year.

X-ray Examination.—Stomach, duodenum, and gall bladder are negative. Clysmia reveals "napkin-ring" cancer of hepatic flexure. At operation, a hard, annular tumor of hepatic flexure, the size of a lemon, was found firmly fixed to the under surface of the right lobe of the liver.

Pathology.—Adenocarcinoma of the hepatic flexure, with metastases in the regional lymph nodes.

That there are other individual causes for faint shadow, there can be no doubt. The important fact is that, regardless of whether the dye is given orally or intravenously, the finding of a faint shadow usually indicates pathology. It should always be carefully studied and checked by at least one re-examination, especially if surgical interference is contemplated.

NO SHADOW

The above remarks concerning "faint shadow" apply in a measure to "no shadow"

tion elsewhere in the biliary system than in the gall bladder. All are agreed that gallstones are the most common cause of cystic-duct obstruction, but what explanation can be offered for the case with a patulous cystic duct and still "no shadow" is present? In such a case what is preventing the opaque bile from entering the gall bladder? It must be conceded that no single explanation can account for all of the cases in this group. We are firm believers in spasm or edema of the cystic duct accounting for many cases of "no shadow" on the first examination in which a

shadow is present on re-examination. Constriction from adhesions accounts for some obstructive cases and extrinsic pressure from tumor or inflammatory masses may produce obstruction in certain cases. Allowing for these exceptions, there are still a number in which the explanation must be more or less theoretical. A number of possibilities have been offered.

(1) The inflammatory process in the gall-bladder wall (cholecystitis) causes more rapid absorption of the dye than normal, so that by the time the films are taken, the percentage of iodine in the opaque bile mixture is not sufficient to render the gall bladder visible (Bronner and Schüller, 2).

(2) The inflammatory process inhibits cell activity so completely that water is not absorbed and the dye is not concentrated (Chiray and Panel, 6).

(3) The inflammatory process causes breaking up of the bile-dye combination; the toxic products interfere with the chemical union of the dye and bile (George Rohdenberg, 7).

(4) The wall of the gall bladder is abnormally thickened, the lumen is smaller, and there is insufficient opaque bile-dye content to cast a shadow.

(5) Bile is abnormally thickened (tarry or axle-grease consistency) and not miscible with the dye.

(6) The gall bladder is so filled with non-opaque stones that an insufficient amount of dye-impregnated bile can enter the gall bladder to give a shadow, even though the cystic duct be patent.

(7) It is possible that some disturbed physiological action between the gall bladder and the sphincter of Oddi may prevent opaque bile from entering the gall bladder (Naunyn), but this has never been demonstrated.

(8) Kirklin (8) claims a meal containing fats in the evening just before taking the dye (oral test) results in 25 per cent

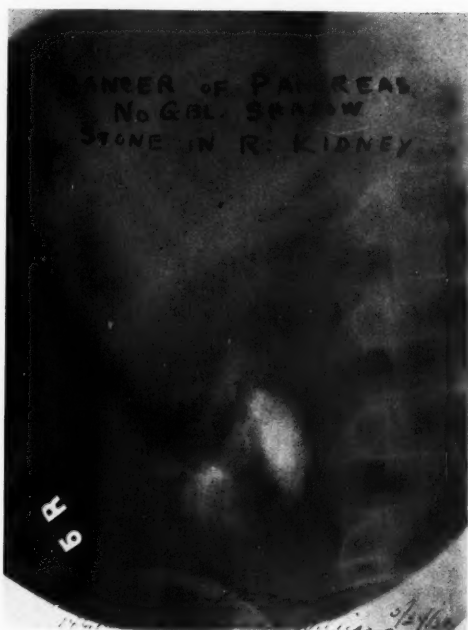


Fig. 14. Illustrating kidney stone found on routine Graham examination. The patient had had pain in the abdomen for the past seven weeks, and had been confined to bed for four weeks. Frequent vomiting; liver enlarged on examination; no shadow on Graham test; renal stone.

Operation.—Liver large, pale yellow; gall bladder hidden in dense omental adhesions; large hard mass in the head of the pancreas; stone could be palpated in the right kidney.

more cases of "faint or no shadow" than if a fat-free meal is allowed.

(9) Lahey and Jordan (9) blame the colon and state that "in 44 per cent, in a series of 65 cases, the gall bladder filled normally after 5 to 10 days of bowel management; whereas, with the same intravenous technic it had previously shown an absence of filling or inadequate filling." Why functional or spastic irritability of the colon should have any influence on *intravenous technic* does not seem clear, since the dye is administered directly into the circulation, but in any event, a large percentage of cases, nearly half, required re-examination to obtain a normal shadow, when there was presumably no disease of the gall bladder. It

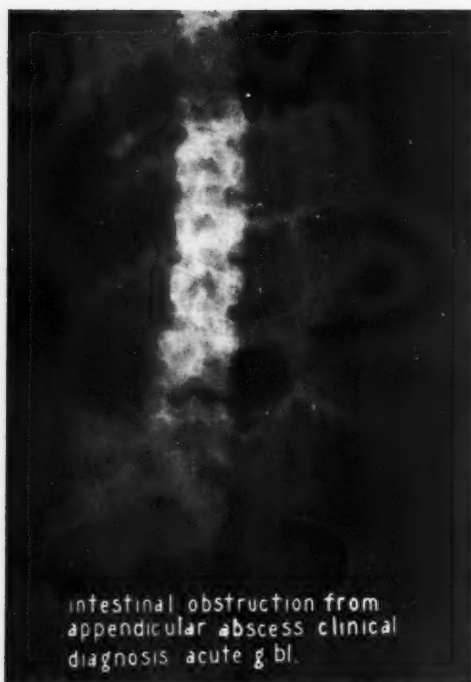


Fig. 15. Clinical diagnosis was acute cholecystitis but roentgenograms demonstrated intestinal obstruction. The patient complained of diffuse abdominal pain, with vomiting; pain in epigastrium (no relation to meals); abdomen moderately distended.

X-ray Examination.—Dilated intestinal coils.

Operation.—Acute appendicitis, with pelvic peritoneal abscess; acute ileus due to inflammatory adhesions of the lower ileum.

is interesting to conjecture whether a spastic colon may produce or be associated with a spastic cystic duct.

(10) Kretschmar (10) has a tabulation of 19 cases of "no shadow," three of which gave a normal shadow on repeating the test (intravenous technic).

Defective liver function, hepatitis, or cirrhosis may in rare cases prevent the bile from becoming opaque. That there will always remain a certain number in which an explanation of "no shadow" is impossible, there can be no doubt.

DEFORMITY OF THE SHADOW

Throughout the last five years' experience in cholecystography we have noted with in-

creasing frequency deformities of the gall-bladder shadow of varying nature; elongations, sacculations, folds, angulations, constriction, etc., have been observed in gall bladders which gave a normal response to the dye. We have concluded that they are in the nature of anomalies, and this opinion has been sustained by the study of many cases operated upon. However, one must distinguish between deformities of this class and those caused by pericholecystitic adhesions. In the latter, there is usually a malposition, with or without evidence of traction (Figs. 9 and 10). The long axis of the gall bladder is commonly directed inward, instead of downward or outward. The edges of the shadow are apt to be roughened and irregular, especially in the presence of stones.

With a typical normal response to a meal the gall bladder contracts to about one-quarter its size when distended. Such a finding rules out any dense adhesions from pericholecystitis, but a "fadeaway" emptying, without any evidence of contraction, is strong supporting evidence of adhesions involving the serous coat.

Beware of those cases which give a perfectly normal cholecystographic response without deformity and still have persistent drawing pain. We have seen such findings in at least six cases. About the only roentgenographic signs are a slight malposition of the gall bladder with possibly some tenderness and fixation when palpated under the screen. However, the gall bladder is normally so closely attached to its liver bed that efforts to demonstrate fixation by palpation are very difficult; in fact, we have found fluoroscopy almost impossible unless the subject is very favorable. In all these cases the gall bladder was found embedded in omental adhesion.

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS BY MEANS OF THE GRAHAM TEST

Patients referred for X-ray examination

of the gall bladder fall roughly into three groups:

(1) Those in whom the clinical symptoms are typical, the diagnosis of acute gall-bladder disease has already been made clinically, and there have been attacks of unquestioned biliary colic, the X-ray examination being made simply for what additional information it may yield.

(2) Those with vague, indefinite abdominal distress whose main complaint is gas, belching and flatulence, with very little pain, in whom the X-ray examination is made with the hope that it will lead to a positive diagnosis or else rule out organic disease.

(3) Lastly, those with no gall-bladder complaint, in whom a thorough search is being made for focal infection or as part of a clinical "work-up." The gall bladder may not even be under suspicion, but gallstones have been found during a routine examination of the gastro-intestinal tract, urinary system, or spine.

In the first group, there is only rarely any failure to confirm the clinical diagnosis, but in the second and the third groups the differential diagnosis is more difficult and the Graham test is often of great value. It is in these cases that the clinical history and findings may be very indefinite, while the X-ray, when positive, is of real aid in establishing a correct diagnosis. Moreover, while one lesion is usually the cause of the patient's symptoms, especially in acute manifestations, yet in chronic cases there may be two or more lesions. Chronic appendicitis and chronic cholecystitis are frequently associated; so are chronic pancreatitis and chronic cholecystitis or duodenal ulcer with chronic cholecystitis. With such multiplicity of lesions, the history and findings may be extremely confusing, while the X-ray gives impartial visualization of the existing pathology.

The most common double lesion is chronic



Fig. 16. Echinococcus cyst; cholelithiasis and cholecystitis. The patient, 60 years of age, for several years has had occasional attacks of pain in the right upper quadrant, radiating to the back and the shoulder blade; nausea but no vomiting; frequent gaseous eructations, with relief from pain; anorexia.

X-ray Examination.—Mass just above and to the outer side of the gall bladder, which is calcified; probable echinococcus cyst; non-opaque gallstones.

Operation.—Echinococcus cyst and gallstones.

cholecystitis and chronic appendicitis. When the cecum fails to descend into the iliac fossa, the appendix may be in the right upper quadrant and defy differential diagnosis without the X-ray (Fig. 11).

Duodenal ulcer may accompany gall-bladder disease (Fig. 12), but it is more often found as a single lesion when the gall-bladder disease has been diagnosed clinically. Such findings are so frequent that the stomach and duodenal bulb are routinely outlined following the Graham test. It has been stated by some authors that in the presence of duodenal ulcer the cholecystographic findings in the vast majority of cases will be

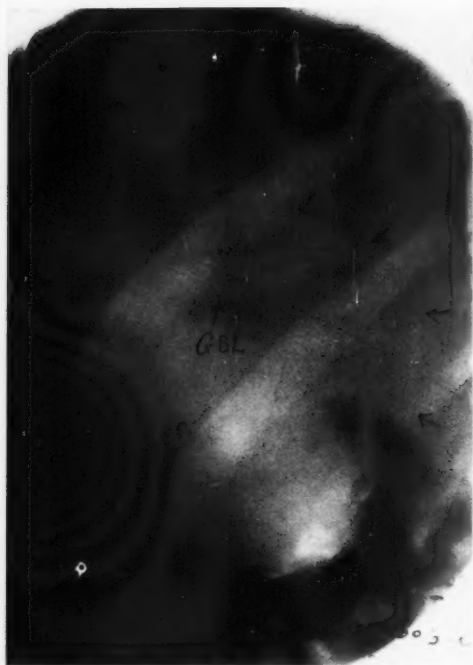


Fig. 17. Echinococcus cyst. The patient, 40 years of age, has complained for 19 months of pain and burning in the stomach upon taking food. He has lost fifty pounds in weight in the last two years. Has a mass beneath the liver the size of an orange.

X-ray Examination.—Gall bladder is displaced upwards by a rounded mass; lower rim is calcified.

Operation.—A cyst in the lower border of the right lobe of the liver.

Pathology.—Echinococcus cyst of the liver.

"no shadow." Our experience does not justify such a statement. When we obtain a "no shadow" in the presence of a duodenal ulcer, it is usually due to a double lesion.

Gastric ulcer and cancer frequently give symptoms referable to the gall bladder. Even the best of internists would not venture in many cases to make the differentiation without the aid of the roentgen examination, and these remarks are pertinent to cancer of the colon, a palpable mass being taken for an enlarged gall bladder (Fig. 13).

Cancer of the pancreas, gall bladder, and liver usually results in a "faint shadow" or

"no shadow" on examination with the Graham test, and differential diagnosis cannot be made (*i.e.*, with the Graham test). This gall-bladder finding, in the opinion of the authors, is due to associated pathology.

A stone in the right kidney may present a strikingly similar clinical picture to gall-bladder disease. Kidney stones present a variety of forms, from round or oblong to those with sharp, spike-like projections, usually quite dense, while gallstones are typically ring-like or faceted when calcified. The oral Graham test is a much more simple differentiating test than pyelography. We may have a double lesion as in Figure 14. This patient suffered from a carcinoma of the head of the pancreas, as well as nephrolithiasis. The gall-bladder finding was "no shadow," due to adhesions.

Small intestinal obstruction, with cramps, may be confused with biliary colic. Here a single film of the abdomen demonstrates the distended intestinal loops (Fig. 15).

An echinococcus cyst of the liver is occasionally seen, causing symptoms that are difficult to differentiate, without cholecystography, from a gall-bladder lesion (Figs. 16 and 17).

SUMMARY

(1) The most efficient technic for oral cholecystography of to-day as a result of five years' experience has been outlined.

(2) Every "faint shadow" and "no shadow" finding should be re-examined for confirmation as a routine.

(3) Maximum contractility of the gall bladder after a meal must be demonstrated as part of a normal cholecystographic response and to rule out pathologic involvement.

(4) Theories are outlined for cause of "faint shadow" and "no shadow."

(5) Cholecystographic findings in various lesions of the biliary tract are men-

tioned, with illustrations of differential diagnosis.

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IRRADIATION OF TUMORS, WITH SPECIAL REFERENCE TO RADIOSENSITIVE TUMORS¹

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THIS brief review is based on the experience of nearly eight years, during which we have irradiated certain types of tumors with superficial and deep X-ray. Most of the experience was obtained in the treatment of cases observed both by Dr. Bloodgood and the author, and the diagnosis was based on clinical, X-ray, or microscopic evidence and not infrequently on all three. Dr. Bloodgood published a thorough review of radiosensitive tumors in *RADIOLOGY* in March, 1930. The present review is chiefly of tumors considered inoperable, most of them large and either inaccessible or not easily accessible by operation. As a rule, the more malignant the tumor the more radiosensitive it is likely to be; for example, lymphosarcoma and certain other types of sarcoma—embryonal cell sarcoma. There are some exceptions, which will be mentioned later in the case reports. Of the curable types of tumor, basal-cell cancer is well known to yield to irradiation, and since this type of cancer frequently attacks the skin superficial irradiation is usually sufficient to bring about a cure. Basal-cell cancer is mentioned simply to call attention to the fact that irradiation as well as surgery will produce a cure, and also that it falls in the radiosensitive group. When properly treated either by X-ray or surgery, it seldom recurs. Fibromas or fibrosarcomas belong to a type of tumor more or less radiosensitive, and, while some of them will yield to irradiation and the patient remain clinically well for five years or more, others are only temporarily benefited, recur, and have to be surgically removed. Tumors of this type, therefore, fall in the group of moderate curability and

it is always advisable to try irradiation before operation. Such a tumor is somewhat slow-growing and not infrequently involves the nerve sheath. One case of fibromyxoma of the antrum and nares and another case of fibromyxosarcoma involving the antrum and ethmoidal region, treated with the deep X-ray, are up to the present time clinically well at two and two and a half years, respectively. These, with a few other cases, are taken from a large number of various types of tumors treated in the past eight years, and are reported because they present points of unusual interest. No attempt has been made in this study to make it embrace a complete review of radiosensitive tumors.

CASE REPORTS

Case 1. This case is extremely interesting as being an instance of a markedly radiosensitive tumor which proved highly malignant. The patient, H. J. R., white male, aged 56, consulted Dr. Bloodgood in April, 1930, about a growth on his forehead, which had been present for about ten or eleven months. When first noticed it approximated the size of the end of the index finger. It has slowly grown to the present size, occasioning no actual pain, no headaches. The patient feels a little uneasiness there, and cannot wear a hat on account of pressure. The trouble had been present about three or four months before he consulted a physician, who advised leaving it alone, and the case, therefore, received no treatment until January, when the man consulted another physician, who gave him injections in the arm without result.

On physical examination a large palpable tumor was found in the abdomen, and the

¹Read before the Radiological Society of North America, at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1-5, 1930.

patient complained of indigestion. He also had a tumor of the right testicle which had been present for eighteen months. The right testicle was surgically removed by Dr. Bloodgood on April 8, 1930, and the

to return in June with a recurrence of the tumor on his forehead and the tumor in his abdomen. A second course of irradiations was given, and, while both tumors regressed somewhat, he gradually grew weaker and



Fig. 1. Case 1. Metastasis to the frontal bone and the overlying soft structures from sarcoma of the testicle. Before deep irradiation.



Fig. 2. Same case as shown in Figure 1. Note the rapid regression of the soft-structure tumor five days after deep irradiation. There was evidence also of some improvement in the metastasis to the frontal bone.

microscopic sections revealed a highly cellular embryonal type of sarcoma. X-ray examination of the head revealed destruction of the frontal bone, particularly of the outer table immediately above the frontal sinuses, with infiltration and swelling of the overlying soft structures. The abdomen revealed no demonstrable tumor nor calcification, although a mass was easily palpable. Deep irradiations were begun in April, 1930, first over the forehead and then over the abdomen. The mass over the forehead rapidly became smaller and flattened out, whereupon we could feel the roughened bone beneath. Similarly, the mass in the abdomen rapidly disappeared so that it was no longer palpable, and the patient's symptoms of indigestion disappeared about this time. He felt better after the course of irradiations than he had done for months. He went to his home in another city, only

died in July, 1930. This case is reported somewhat in detail because of the extreme radiosensitiveness of the metastatic tumors of both the forehead and abdomen, associated with a high degree of malignancy.

Case 2. A somewhat similar case, the patient having a tumor of the testicle, with metastasis to the abdomen. He is living and clinically well after seven and a half years. The patient, G. W., a white male, aged 42, married, entered the hospital in July, 1923, complaining of pain in the abdomen and in the right lumbar region radiating to the right ureter. On examination, the left testicle was found to be apparently normal. The right testicle was absent. There was a spherical mass in the upper abdomen which seemed to be fixed and very rigid. When palpating the kidney area on either side, the mass—about the size of a grapefruit and near the mid-line—did not move.

X-ray examination of the chest was negative, revealing no evidence of metastasis. X-ray studies of the gastro-intestinal tract revealed difficulty in filling the pylorus and duodenal bulb, due to pressure from an

who removed the right testicle in March, 1923, stated that section of the tumor revealed an embryonal type of carcinoma. He also stated that an inguinal adenitis was present one year prior to the appearance of



Fig. 3. Case 3. Metastasis in the region of the right hilus, with a curved metastatic shadow extending upward and outward to the periphery, following surgical removal of an ovary for sarcoma. Before deep irradiation.

extra-gastric tumor. There was also some degree of ileal and cecal stasis. An exploratory operation was done by Dr. George A. Stewart, whose note follows: "Right rectus incision—exploration of the abdominal cavity. Nothing in the scar or gall-bladder region but near the mid-line in region of the kidney there lay a large mass which was nodular in character and lay beneath the peritoneum. There was no glandular enlargement. It was impossible to move this mass freely and we could not trace a direct communication with the kidney itself on this side. The entire mass was in such a position and seemed so large and near the large abdominal vessels that we did not believe it advisable to remove it. No glands could be obtained for diagnosis. From the previous history we thought this to be a malignant metastatic tumor, although we could not get a section." A brief note from Dr. J. McRea Dickson, of Gettysburg, Pa.,

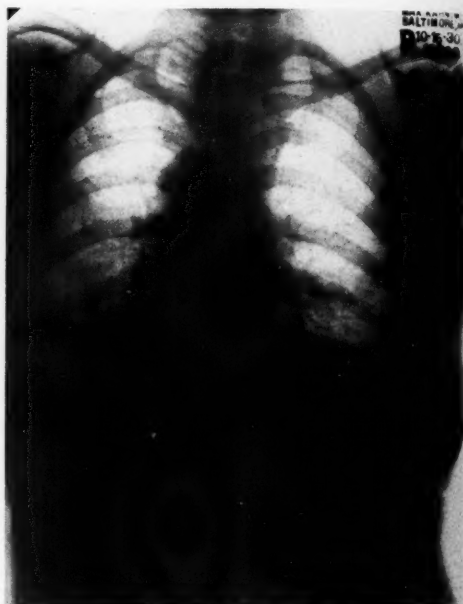


Fig. 4. Same case as shown in Figure 3, five years after deep irradiation. The lungs are clear and there has been complete disappearance of the metastatic shadows. Patient is clinically well.

the growth. The patient received deep X-ray treatments during August, September, and October, 1923, and also during October, 1924, but none since. He was seen at the office about five years after irradiation and at that time there was no palpable tumor in the abdomen and he was clinically well. In answer to a recent inquiry, Dr. Dickson, under date of October 28, 1930, now about seven and a half years after irradiation, writes as follows: "I saw Mr. W. about four months ago. There has been no return of the tumor and he is apparently cured." There is undoubtedly a similarity between these two cases of embryonal cell tumors, with the exception that the second

had no metastasis other than in the abdomen, while the first had metastases to the abdomen and to the skull. Both yielded rapidly to irradiation and were extremely radiosensitive. In one case the patient died

in the region of the hilus, gradually extending upward and outward toward the periphery. There was marked infiltration in the region of the right hilus, with a widened mediastinal shadow extending upward.

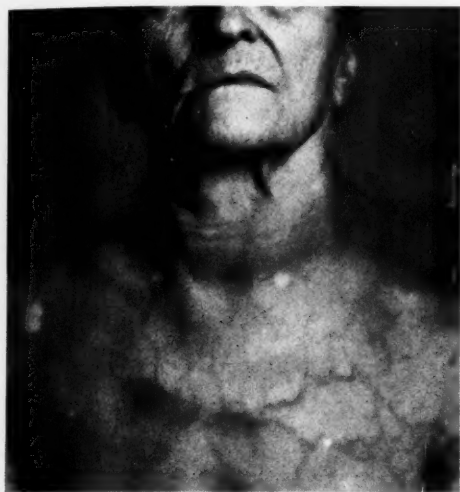


Fig. 5. Clinically, a case of cystadenoma of the thyroid before deep irradiation, showing how pressure has produced distention of the superficial veins.

about three and a half months following the first course of irradiation, while the other patient is living and clinically well and apparently cured seven and a half years later.

Case 3. Miss M. B., white female, aged 64, was first seen by Dr. Bloodgood in September, 1925. Three years before she had been operated upon by Dr. William J. Coleman for appendicitis and he had found also a sarcoma of the ovary. On physical examination she was seen to have numerous warts, beginning in the mid-line of the abdomen and extending to the chest. There was also a mass in the right upper quadrant of the abdomen. Her chief complaint was dyspnea, but otherwise she felt well. X-ray examination of the chest revealed a dense curved line, corresponding approximately to the region of the right upper and middle lobes. This dense line appeared to originate

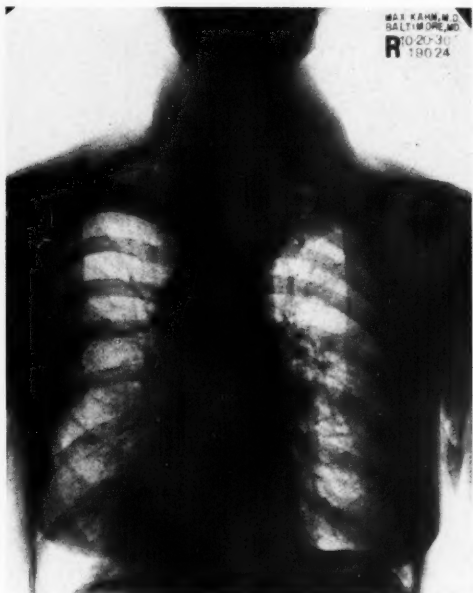


Fig. 6. Same case as shown in Figure 5. Note the infiltration and extension of the cystadenoma to both apices, particularly the right.

There appeared to be also some increased widening of the left upper mediastinum. X-ray examination of the abdomen revealed no tumor shadows, and both kidneys were visualized and appeared normal in size and position. Dr. Bloodgood studied the sections of the tumor removed by Dr. Coleman and his note on the sections is as follows: "It is distinctly a sarcoma; cells larger than lymphosarcoma. It belongs more to the endothelial sarcoma type, not unlike Ewing's type of endothelial myeloma of bone. This tumor reacts readily to radium and X-ray."

The patient received deep irradiation over the lungs and mediastinum from September to November, 1925. She responded to irradiation rapidly so that the dense shadow

in the lung and the widened mediastinal shadows disappeared. The warts on the abdomen were excised by Dr. Bloodgood in December, 1925, and proved to be benign pigmented moles. The patient was seen at long intervals and was also under the care



Fig. 7. Same case as shown in Figures 5 and 6, showing regression of the cystadenoma of the thyroid after a course of deep irradiation. Pressure has been relieved and distention of the veins has disappeared.

of Dr. John T. King, who in a personal conversation recently stated that the mass in the right upper abdomen has remained about the same in size and is symptomless. Following irradiation over the chest the patient has had no recurrence of dyspnea. X-ray examination of the chest made in October, 1930, five years after irradiation, reveals the lungs and mediastinum to be essentially negative. The patient feels well and is able to attend to her usual household duties.

This case is an illustration of a metastatic malignant tumor involving the lungs and mediastinum, clinically well and symptom-free five years following irradiation.

Case 4. H. S. M., Jr., a white male, aged 15, had his tonsils and adenoids removed in October, 1927. At that time he was breathing badly, mostly through his mouth. One month later he had bleeding from the nose—

three hemorrhages. At examination, when first seen in August, 1928, he was still breathing through his mouth. There was swelling of the right cheek, extending from the region of the zygoma down to the lower jaw, causing slight bulging of the eye and marked bulging of the right cheek. On palpation with one finger inside the mouth and one out, a small irregular mass which slid underneath the fingers could be felt. High up in the right side of the nose a grayish mass could be seen. He had had several epistaxes at infrequent intervals. Dr. Bloodgood's impression was that we were dealing with a tumor palpating like a multiple fibromyxoma and involving in all probability the nasopharynx, antrum, cheek, and temporal fossa and that it was not malignant. X-ray examination of the nasal accessory sinuses revealed, chiefly, clouding of the right maxillary sinus and right naris, strongly suggestive of a tumor, with some displacement of the nasal septum to the left. The walls of the maxillary sinus appeared intact. The heart and lungs were negative. On August 15, 1928, both external carotid arteries were ligated. A course of deep X-ray irradiation was begun during August, 1928, after ligation of the carotids, repeated again in January, June, and October, 1929. The epistaxis stopped immediately after the first X-ray treatment and has not recurred. The swelling of the right cheek and bulging of the eye gradually subsided, as well as the mass in the right side of the nose. X-ray examination of the nasal accessory sinuses in October, 1929, revealed decided improvement in the appearance of the right maxillary sinus, in that it was clearer and the walls of the antrum were better defined; there was also less clouding of the right naris. Dr. Bloodgood saw this patient in March, 1930, and noted that the swelling of the right cheek and bulging of the eye had gone and that the patient was breathing through the right naris.

This case illustrates that the tying of the external carotid arteries, combined with deep irradiation, has produced a marked improvement in a case of fibromyxoma, so that the patient is now clinically well, two and a half years after treatment.

Case 5. The patient, O. J. O., a white male, aged 28, stated that he had been absolutely well in every way until January, 1928, when, he believes, his trouble began with a bad cold which settled over his left eye. He consulted a physician about that time who told him he had sinus trouble, and the left sinus was drained two or three times. The condition cleared up and he was not troubled again until the following March. The same symptoms returned at this time, with watering of the eye, and he felt as if the eye was being pushed out of the socket. He had headaches over the left frontal area extending to the occiput. He returned to his physician, who treated him again for the left frontal sinus and the symptoms cleared up, but the left side of his nose felt "stopped up," and since then he has been unable to breathe through the left naris. His physician removed a piece of the turbinate in May, 1928, which revealed chronic inflammation, and after that time the patient had little trouble until three weeks previous to our examination. About August 1, 1928, he noticed a swelling of the left side of his face and a little swelling inside his mouth. He was first seen by us on August 11, 1928, and at that time there was a slightly visible swelling of the left side of the face over the left antrum. In his mouth we saw a swelling larger than a twenty-five-cent piece of the left upper jaw. The first and second molars had been extracted, the third was still in place. The tonsils were large. On palpation the mucous membrane over the tumor was smooth and beneath it one could palpate a mucous mass with a bone shell. X-ray examination of the sinuses made elsewhere four weeks before revealed clouding

of the left antrum, with a suggestion of partial destruction of the anterior wall. He was operated upon by Dr. Bloodgood on August 15, 1928, a brief abstract of whose operative note follows: "An intramural in-

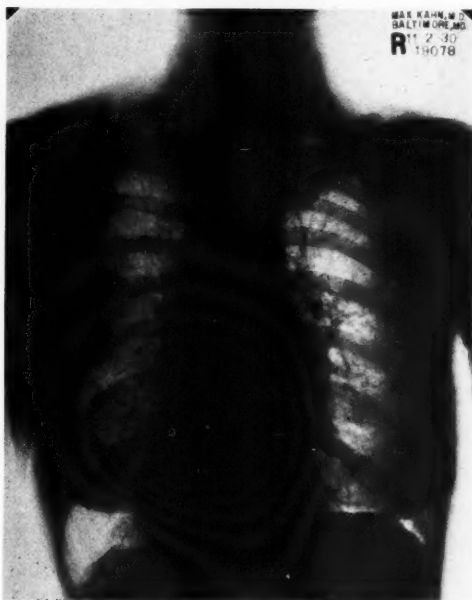


Fig. 8. Same case as shown in Figures 5 to 7. There has been marked absorption in the region of the apices of the infiltration from the cystadenoma of the thyroid, following deep irradiation.

cision along the upper lip to the nose was made, partly excising the external tumor with the cautery. The frozen section revealed sarcoma. On opening the antrum with cauteries (electric, Cameron and plumber's irons), it was impossible to remove all the tumor, as it extended behind the orbit and into the ethmoids. The tumor left behind was coagulated, but all of the tumor was not destroyed with the cautery. Microscopic examination revealed sarcoma of the antrum, round-cell in type, beginning in a fibromyxomatous tumor."

He received a course of deep X-ray irradiation in August and another in November, 1928, over the left antrum and left ethmoi-

dal region. X-ray examination of the chest revealed no positive evidence of metastasis, and X-ray examination of his sinuses on November 24, 1928, revealed the frontal sinuses unequal in size and a little hazy, probably due to the hypertrophied mucous membrane. There was destruction of the left maxillary sinus and malar bone—it was difficult to tell how much of this was due to surgical intervention and how much to neoplasm. The swelling over the left side of the face became less and gradually receded, soon after the first course of treatments.

The patient lives in a distant city and has written at various intervals, reporting his condition. In his last report in July, 1930, he states that he is in the best of health.

This case illustrates a patient with a round-cell sarcoma in a beginning fibromyxomatous tumor involving the antrum, who had an exploratory operation and who is now living and well two years following deep irradiation.

In conclusion, I wish to call attention again to the fact that the highly malignant tumors are usually also highly radiosensitive, and do not necessarily offer a bad prognosis. On the contrary, I desire to emphasize that deep irradiation offers much hope in some types of malignant tumors and that irradiation is the method indicated in those cases in which the location of the tumor makes the lesion inoperable or its complete removal impossible.

DISCUSSION

DR. FRANCIS CARTER WOOD (New York): Dr. Kahn's paper illustrates admirably the position in which we now find ourselves able to cure without any surgical intervention a certain number of cases which, ten years ago, would have been absolutely incurable: there is no question about it. Unfortunately the numbers are few, but the results are certainly definite. In regard to the fibromyxoma of

the nasal passages, in that case the operation of ligation of the external carotid could have been omitted, because it is perfectly well known that those fibromyxomas yield admirably to radiation by insertion of radium needles—an effective method, especially if the tumor is large and the needles can be inserted directly. If you can get near the base, the whole tumor will often disappear in the course of a few weeks. If it is not possible to get an approach to the tumor, external radiation will usually cause it to yield, in my experience, in a very short time without the necessity of interfering with the circulation.

Unfortunately, our diagnosis of the testicular tumor is still complicated by a series of names. We speak of "embryonal sarcoma"—it means one thing, and a "seminoma" probably means the same thing. We all know that the tumors known as "seminomas" are extraordinarily sensitive to radiation and are not good subjects for surgery, because the growth metastasizes early, often before the patient comes to the surgeon, and frequently before the patient will consent to operative removal of the affected testicle. Most of these cases show abdominal metastases and if the patients are heavily radiated they will sometimes be cured. Sometimes the tumors recur and are not sensitive, and the patient goes the usual course. On the other hand, the definite teratoid types, with carcinoma, are, as a rule, absolutely resistant to radiation, even in enormous dosage, and in patients with such neoplasms, while occasionally the pain may be palliated for a few months, death almost always follows within a year. Thus the importance of biopsy and careful study of our slides is obvious. What I wish to insist upon is that every patient has a right to a biopsy and it should be the medical-legal obligation of the surgeon to preserve a series of slides for future study for the benefit of that patient. Every case furnishes a little information for our future work, and if slides are carefully preserved as records, photomicrographs can be made and included with every published report, so that we can ultimately get some more definite information concerning the radiosensitiveness of these disease processes. As you know, I

doubt the possibility in all cases of determining radiosensitiveness by the microscope, and I have ample evidence to back up that opinion. Take the so-called "Ewing tumors"—a bad name because it does not describe the tumor; some are sensitive and some are not. Among

patients radiated in exactly the same way, some will die without the radiation having had apparently any effect on the tumor, and in others the tumor will disappear. Our microscopic slides do not tell us always the biology of the tumor.

ATOMS ARE WANDERERS EVEN IN SOLID METAL

Atoms, even the heavy atoms of lead, are wanderers. Prof. J. G. von Hevesy, of the University of Freiburg in Breisgau, has been investigating their properties. Lead atoms are constantly in motion, even in solid metal, he believes. In an alloy of lead and

gold, at a temperature half again as high as that of boiling water, the atoms wander through a space of a hundredth of a cubic inch in a day. When there is nothing but lead in the lump, however, moving about is not nearly so easy; in pure lead an atom can migrate in one day through a space of only two ten-billionths of a cubic inch.—*Science Service*.

ON THE SPECIFICATION OF X-RAY QUALITY¹

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INTRODUCTION

IN the measurement and specification of X-ray quality, simplicity is a very desirable feature; the use of tube voltage as an indirect method of hardness specification, and of such methods as penetrometer scale reading, half value layer, effective or average wave length, and absorption coefficient, based on observations made on the X-ray beam, all have the merit of expressing the quality by a single numerical value. Undoubtedly each of these methods has its sphere of usefulness. In the following discussion, however, reasons will be given for considering that none of them is adequate as a general specification of quality and that a single coefficient can hardly be expected to describe the quality of a heterogeneous beam of X-rays with sufficient exactness for all practical roentgenologic purposes. A method of quality specification is proposed which, it is believed, avoids the weaknesses of previous methods in that (1) it describes the quality of any X-ray beam used in roentgenologic practice with satisfactory completeness; (2) it involves but little more work in its measurement than do existing methods of X-ray quality specification; (3) more information of practical importance can be derived from this method than from other methods, and (4) the other principal methods of quality specification such as half value layer, effective wave length, absorption coefficient, and homogeneity coefficient can easily be derived from this method. The method, in brief, is to express the radiation quality simply by the relation between the transmission of the X-rays by a given filter material and the thickness of the filter.

Probably the most suitable way of ex-

pressing this relation is to plot the curve of $\log \frac{I}{I_0}$ against filter thickness, where I_0 is the intensity incident upon the filter, and I the intensity transmitted by the filter; $\frac{I}{I_0}$ is, therefore, the transmission. $\log \frac{I}{I_0}$ is equivalent to $\log I - \log I_0$, so that the curve of $\log I$ plotted against filter thickness is identical with that of $\log \frac{I}{I_0}$ against filter thickness except for a shift of the whole curve along the $\log I$ axis by an amount $\log I_0$. It is the form of this curve which describes the quality of the radiation; therefore, it is immaterial whether $\log I$ or $\log \frac{I}{I_0}$ is plotted against filter thickness as a specification of the radiation quality. In the following discussion this curve will be called the *absorption curve*. A group of such curves, of $\log I$ plotted against thickness of copper filter for various X-ray tube voltages (constant potential), are shown in Figure 1. These are taken from a recent paper by L. S. Taylor (1). This is a graphical, rather than a numerical, specification of quality; the interpretation is made ordinarily by visual inspection of the curve. Two or more curves can be compared, preferably by superimposing them, so that their similarities and differences can readily be noted. For instance, in the curves of Figure 1, the most obvious and significant difference among them is in the average slope of the curve, which varies with the tube voltage; other significant features are the degrees of curvature in different curves and the variation in curvature from one part of a curve to another. The data plotted in such curves may also be presented in tabulated form,

¹Presented before the Commission of Measures, Third International Congress of Radiology, Paris, July, 1931. Communication No. 480 from the Kodak Research Laboratories.

so that others may plot the curves in suitable form for the most convenient comparison with other such curves, or for other methods of analysis.

DIFFICULTIES IN THE SINGLE VALUED SPECIFICATION OF QUALITY

Under some conditions it is entirely feasible to describe the quality of a heterogeneous beam of radiation by a single number. In any case in which the wave length intensity distribution is uniquely determined by a single variable factor the quality may be completely specified by giving the numerical value of that factor. It is well known that the quality of the total radiation emitted in a single direction by the target of a given

X-ray tube, operated at constant potential, is determined by the value of the voltage on the tube. But in roentgenologic practice tube voltage has proved unsatisfactory as a general method of specifying X-ray quality because of the variations in voltage wave forms, differences in X-ray tubes, differences in filtration, and difficulties in the reliable measurement of high voltages.

The field of optics supplies an excellent example of the specification of the quality of a heterogeneous beam of radiation by a single numerical value. The quality of the radiation emitted by an incandescent "black body" (a uniformly heated enclosure) is completely determined by the temperature. The quality of any other radiation which can be matched by the radiation from a

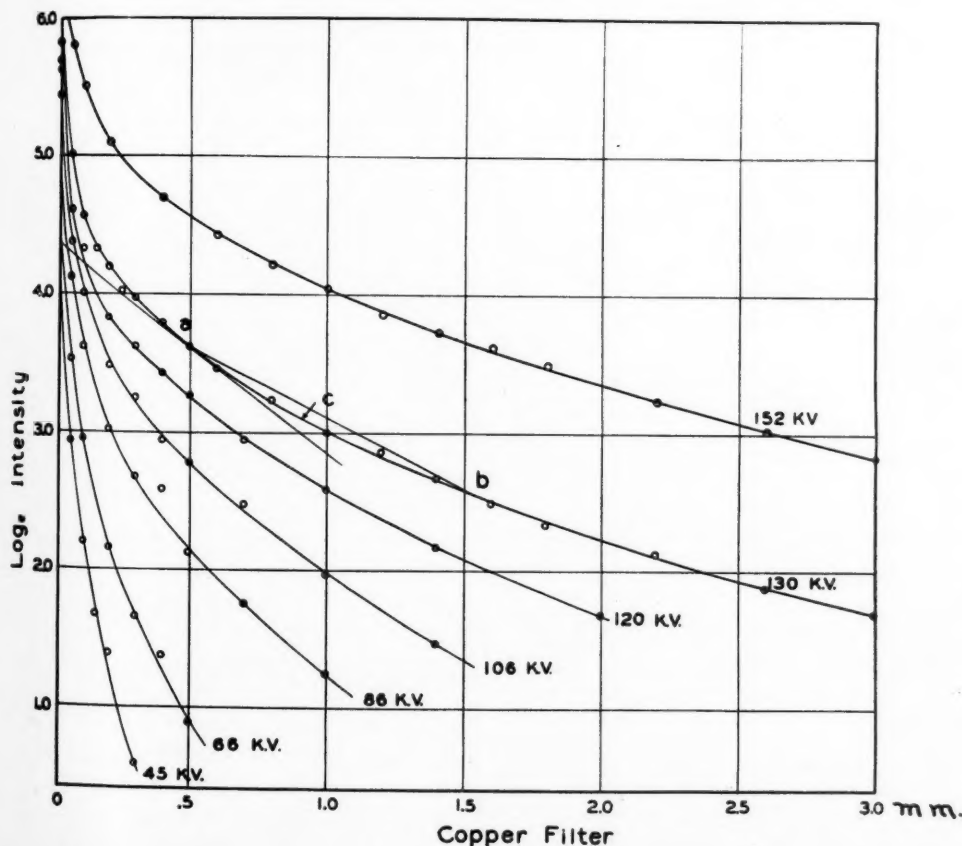


Fig. 1. Taylor's curves for the absorption of X-rays at various voltages in copper (1).

black body operated at a suitable temperature may be specified by the value of that temperature, called the "black body temperature" or the "color temperature" of the radiation. It is common practice to express the

specifying quality has been along lines of greater ease and rapidity of measurement rather than in simplicity of specification or definition.

In the case of X-rays, the routine deter-

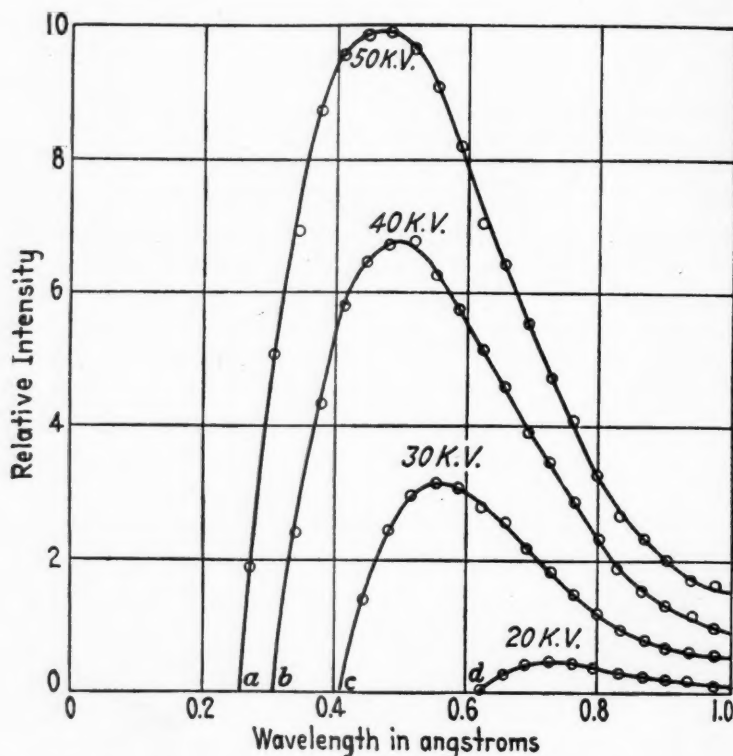


Fig. 2. Ulrey's curves for the spectral distribution of X-ray intensity (2).

color of the light emitted by incandescent solids in terms of color temperature; this temperature is not necessarily the temperature of the body emitting the light but represents merely the temperature at which a "black body" emits light of the same quality.

In general, color or radiation qualities in the field of optics cannot be defined so simply. For purposes of specifying the visual sensation value of a color two numerical values, in addition to the intensity factor, are necessary. For most purposes, the spectrophotometric curve of intensity is required. Improvement in the method of

mination of a spectrophotometric curve is impractical, but because of simplicities in the spectral composition of the X-rays used in roentgenology, such a procedure should not be necessary. Such X-rays consist of a continuous wave length band extending from a minimum wave length determined by the maximum voltage applied to the tube to a long wave length limit (not a sharp limit), determined principally by the filtration. Figure 2 shows some typical spectral intensity curves for X-rays obtained by Ulrey (2). Beginning at the minimum wave length, the intensity increases to a

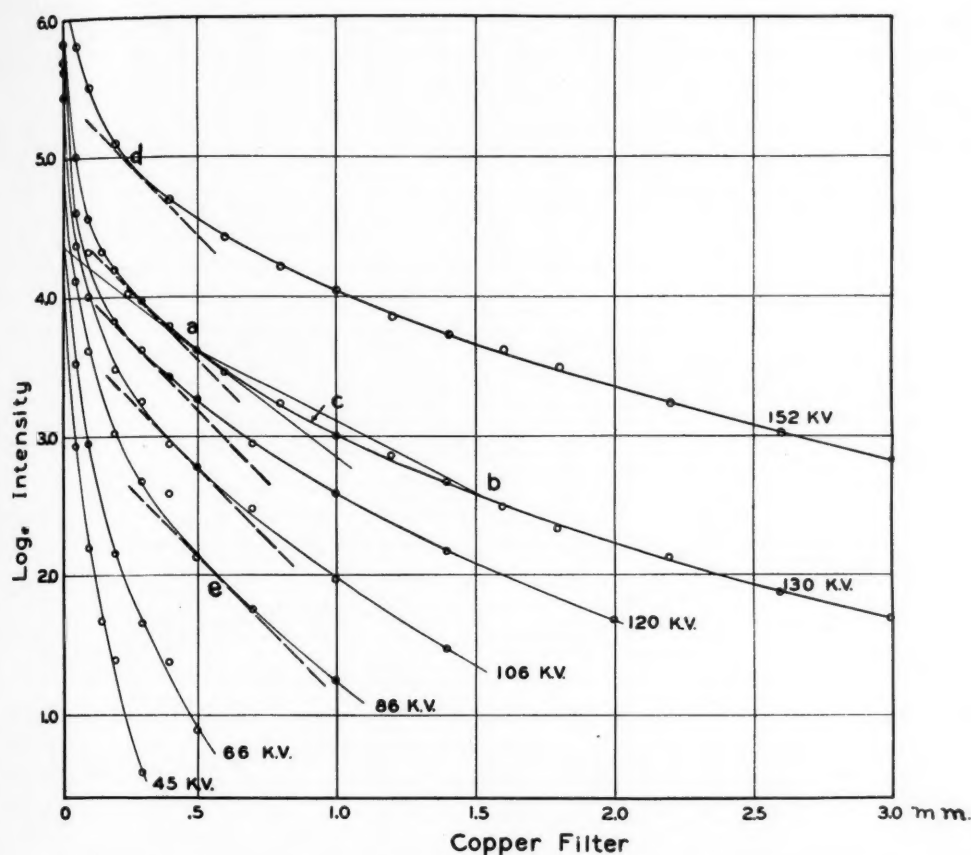


Fig. 3. Reproduction of curves of Figure 1, with tangents of slope 2.0 shown by dotted lines.

maximum and then gradually diminishes. Spectral lines may be superimposed upon the continuous spectrum, but the energy contributed by them is generally but a small part of the energy of the whole X-ray beam. These X-ray spectra are very simple compared to the variations occurring in optical spectra; consequently, greater simplicity in quality measurement and specification is possible, but it may well be questioned whether the extreme simplicity of a single numerical specification of quality can adequately define the various qualities of radiation used in common roentgenologic practice.

The property of X-rays which most read-

ily distinguishes different X-ray qualities is absorption, and the ease of absorption measurement, as compared with the difficulties of spectral intensity measurement, is responsible for the utilization of various absorption methods of measuring X-ray quality. The methods which have been given the most serious consideration—the half value layer, effective wave length, and absorption coefficient—are all essentially alike. Each depends on the measurement of the absorption of the X-rays by a single layer of material. These methods have recently been analyzed experimentally by Taylor (1), who shows how the variability of the results of such determinations is affected by

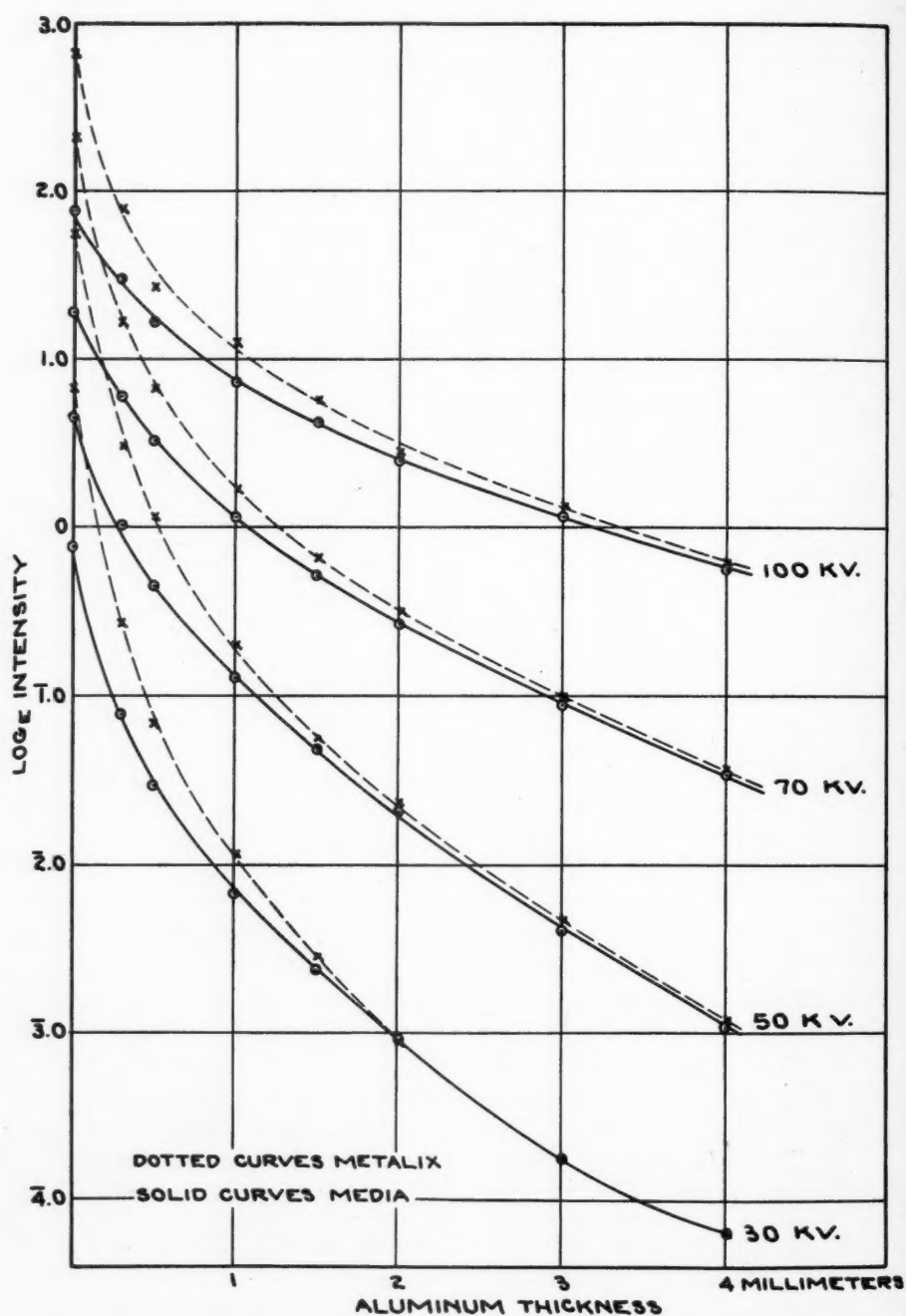


Fig. 4. Neeff's data on two diagnostic X-ray tubes plotted in the form of log I against aluminum filter thickness (7). These data apply to two particular X-ray tubes, and cannot be taken as generally characteristic of the types of tubes named.

the conditions of measurement, especially by the choice of filter thicknesses to be used in the determination of effective wave length. To eliminate this difficulty, and to refine the method, Taylor proposed that the absorption coefficient used in computing the effective wave length be determined from the slope of the tangent to the absorption curve at the filter thickness actually used to filter the X-ray beam. Assume the radiation whose quality is to be measured is that produced by 130 K.V., and filtered by 0.5 mm. of copper (Fig. 1); a tangent is drawn to the curve for 130 K.V. at the 0.5 mm. thickness value. The slope of the tangent at this point (*a*) gives the logarithmic loss of intensity with filter thickness and is equal to the (negative) absorption coefficient. This procedure is equivalent to the use of an infinitesimal thickness of filter for the determination of effective wave length, and, in theory, provides the ultimate refinement in the single filter method of deriving effective wave length.

In a mathematical analysis of methods of X-ray quality measurement, Schwarzschild (3) also shows that the slope of the absorption filter thickness curve is theoretically more exact than the use of a finite thickness of filter for the determination of effective wave length, and he derives the meaning of this slope or absorption coefficient in terms of the spectral intensity distribution in the X-ray beam.

From the curves in Figure 1, it may easily be shown that the same effective wave length values can be derived from various combinations of voltage and filtration. For instance, a tangent of slope 2.0 can be drawn to most of the curves in this chart, and the point at which the tangent touches each curve gives the combination of voltage and filtration producing this one value of absorption coefficient. This is demonstrated in Figure 3, where the curves of Figure 1 are reproduced, with the tangents of slope 2.0 drawn

in dotted lines. The voltage-filtration combinations are listed in the following tabulation.

TABLE I.—VOLTAGE-FILTRATION COMBINATIONS GIVING AN ABSORPTION COEFFICIENT OF 20 (IN COPPER), FROM THE CURVES OF FIGURE 3

K.V.	Thickness of copper filter
86	0.58
106	.43
120	.28
130	.31
152	.28

The effective wave length in this case is 0.23 Å., which means that monochromatic X-rays of this wave length would give a straight absorption curve of the same slope as the tangents drawn in Figure 3.

It has already been pointed out by Failla (4) that radiation quality cannot be specified by a single factor, and in proof of this statement he quotes experiments of Quimby, who obtained the same effective wave length with voltages varying from 125 K.V. to 200 K.V. by suitable choice of filter. Failla recommended that, in addition to effective wave length, the following factors be reported: general character of the high tension apparatus, the peak voltage applied to the tube, and the filter. It is preferable, however, to specify X-ray quality wholly in terms of measurements made on the X-ray beam, rather than to include data pertaining to the generating apparatus, provided this can be done in a satisfactory and practical way.

In specifying the quality of the radiation merely by its effective wave length, there would be no indication as to what combination of voltage and filtration produced the radiation. Perhaps it makes no difference what voltage and filtration were used as long as the effective wave length is the same. Evidence to this effect is reported by Hickey, Pohle, Lindsay, and Barnes (5), who found that two X-ray beams of equal

effective wave length, one produced by 80 K.V. and a filter of 0.2 mm. of copper, and the other by 180 K.V. and 1.0 mm. of aluminum, gave approximately the same skin dose and nearly the same depth dose in a water phantom. A similar observation is reported by Holthusen and Gollwitzer (6).

These two radiations, however, do not have the same spectral quality. Data are not available for the quantitative estimation of the differences in spectral quality, but the character of the difference is fairly obvious; the low voltage and high filtration produce a narrow wave length band, while the high voltage and low filtration produce a wide wave length band. If a large field is radiated under deep therapy conditions, X-ray scattering would do much to equalize the ratio of depth dose to skin dose for two radiations having the same effective wave length but different wave length spreads. In radiography with the Bucky diaphragm, however, the situation is quite different, and in the absence of definite proof it certainly would be unwise to assume that radiations of equal effective wave length would be equivalent radiographically, regardless of differences in the width of spectrum occupied by the radiation. That the penetration effects of two such wave length compositions, as *d* and *e* in Figure 3, are not the same in copper may be shown from the absorption curves of the two; the filtration of each by an additional half-millimeter of copper reduces the intensity of one to 43 per cent, and the other to 52 per cent, of the original value.

Furthermore, it has not yet been proved that the X-ray effects of principal interest in roentgenology—the biological and the photographic—are always the same for the same effective wave length values, regardless of the spectral composition. On the contrary, it would be a remarkable series of coincidences if such were the case. Evidence against such an assumption will be presented in later paragraphs.

The problem of distinguishing between wide and narrow wave length bands having the same effective wave length has been solved theoretically by Schwarzschild (3). He defines a homogeneity coefficient, derived from absorption data, which is a measure of the effective wave length spread of the X-ray beam. It would appear that the combination of effective wave length and homogeneity coefficient would constitute an adequate description of X-ray quality for most purposes; however, as will be shown later, such is not always the case. Furthermore, its determination is rather a laborious procedure, since it involves plotting the derivative of the absorption curve and finding the slope of this derivative at the thickness of filter by which the beam to be described has been filtered. The point is that slope determinations lead to greater irregularities in the specification of X-ray quality than does the use of the absorption curve from which the slopes have been derived.

THE ABSORPTION CURVE AS A QUALITY SPECIFICATION

Schwarzschild states that it may be shown mathematically that only one spectral intensity distribution can be associated with any given absorption curve, so that this curve uniquely defines the spectral intensity distribution. Since the spectral absorption of the common filter materials, copper and aluminum, is more selective than that of tissue, the use of such filters in this method will discriminate more sensitively between the penetrating properties of radiation than is necessary for roentgenologic purposes. Whether this method of quality specification is sufficiently sensitive to differentiate between qualities producing observable differences in biological and photographic effects cannot be stated definitely from the evidence available at present. In view, however, of the uncertainties in the measurements of biological and photographic effects, as com-

pared with the precision of ionization measurements of X-rays, it is highly probable that the absorption curve is amply precise for distinguishing radiations having measurable differences in biological or photographic action.

From these considerations it appears that the absorption curve has all the necessary properties as a specification of X-ray quality, and has many advantages over other methods. It provides a unique description of the radiation quality; it is a simple form of expression recording experimental data without any complicated calculation; the principal facts about the characteristics of the radiation may be derived by simple inspection of the curve; it appears to be sufficiently precise for roentgenologic applications; other absorption specifications of radiation quality can be derived from this method, and further investigations are likely to bring out additional interpretative values of such a curve.

For the higher voltage X-rays such as are used in deep therapy, copper is obviously the most suitable filter material, while the quality of diagnostic X-rays might best be expressed by the use of aluminum filtration. It would be a simple matter from the spectral absorption data on these two metals to derive a method of converting an absorption curve for one of these metals to the equivalent absorption curve of the other for the same radiation. It may be advisable, however, for the sake of convenience, to agree on a definite range of qualities to be specified with aluminum filtration and another range with copper filtration.

QUALITY SPECIFICATION OF DIAGNOSTIC X-RAYS—STUDY OF EXPERIMENTAL DATA

The principal value of the complete absorption curve as a specification of X-ray quality will occur in its application to the ra-

diations used in roentgen diagnosis and superficial therapy. A discussion of the problem of quality specification in these fields follows.

At diagnostic voltages especially, variations in the thickness of glass, and perhaps other factors, in X-ray tubes may cause considerable variations in the intensity and quality of the X-ray output. Occasionally diagnostic tubes are encountered which have an unusually high output of unfiltered rays, while the photographic or fluoroscopic effect through thicker portions of the human body may be but little above the average. Examples of this have recently been reported by Neeff (7) and by Ratti (8). Neeff gives ionization measurements of the X-ray output of two diagnostic tubes at various voltages through various thicknesses of aluminum filter. Figure 4 shows Neeff's data plotted in the form of log *I*-aluminum thickness curves; the dotted curves apply to the Metalix tube and the solid lines to the Media tube. These curves are undoubtedly characteristic of the individual tubes, and cannot be considered applicable to all tubes to which these names are given.

TABLE II.—NEEFF'S DATA (7) ON TWO X-RAY TUBES AT 70 K.V.

Filter mm. Al	r/min. (in air) for 1 ma. and 50 cm. distance		Ratio Metalix/Media
	Media	Metalix	
0.0	3.57	10.20	2.86
.3	2.19	3.37	1.54
.5	1.68	2.28	1.36
1.0	1.06	1.24	1.17
1.5	.75	.834	1.11
2.0	.561	.602	1.07
3.0	.348	.359	1.03
4.0	.230	.238	1.03

Table II gives the ionization readings on the two tubes at 70 K.V.; without filter, the Metalix tube has nearly three times the output of the Media tube, while through 4 millimeters of aluminum the difference in the output of the two tubes is about 3 per cent,

which is doubtless less than the errors of measurement. Beyond 2 millimeters filtration, the curves for the two tubes run nearly parallel, showing but little difference in tube output. It may be concluded that for the radiography of body parts the filtration of which exceeds the equivalent of 2 mm. Al, the two tubes are practically identical, while the skin dose (assuming the tubes are used without filtration) would be nearly three times as great with the Metalix tube as with the Media tube. The absorption coefficient of the unfiltered radiation from these tubes would indicate a considerable quality difference, yet the two tubes are equivalent for diagnostic purposes for most body parts. The absorption curves, however, describe the true state of affairs at a glance, showing both the radiographic equivalence of the tubes, and the difference in skin dose without filtration.

With the curves of Figure 4, as with those of Figure 3, it is possible to select a point on each curve corresponding to a single value of absorption coefficient. Table III gives the values of voltage and filtration on the various curves, for which the absorption coefficient has the value 16.5.

The aluminum filter thicknesses in Table III are all less than one millimeter. The use of absorption coefficient alone as a specification of quality leads to the conclusion that the quality of 30 K.V. radiation could be made equal to that of 100 K.V. radiation by a change in filtration of only a fraction of a millimeter of aluminum. In the light of practical experience, this conclusion is absurd; in fact, radiography of thick body parts at 30 K.V. is wholly impractical. There would be a very large difference in radiographic contrast produced by 30 K.V. and 100 K.V. radiations, and certainly this contrast difference would not be affected to any great extent by the slight changes in filtration required to equalize the absorption coefficients of the two radiations.

TABLE III.—VOLTAGE-FILTRATION COMBINATIONS GIVING AN ABSORPTION COEFFICIENT IN ALUMINUM OF 16.5, OR AN EFFECTIVE WAVE LENGTH OF 0.74 ÅNGSTRÖM (FROM DATA OF NEEFF, 7)

	Tube	K.V.	Filter mm. Al	r/min. for 1 ma. at 50 cm.	Homo- geneity coefficient
1.	Media	30	0.5	0.216	0.632
2.	Metalix	30	.76	.197	.595
3.	Media	50	.32	.993	.617
4.	Metalix	50	.69	.730	.609
5.	Media	70	.18	2.59	.616
6.	Metalix	70	.48	2.39	.653
7.	Media	100	.10	5.47	.669
8.	Metalix	100	.39	5.37	.663

If all the radiations listed in Table III have equivalent quality, then any given radiographic exposure should require the same number of roentgens of exposure with each of them. For instance, at 100 K.V. and 0.10 mm. aluminum filter, the output of Media tube measured in roentgens per minute is 5.5 times that at 50 K.V. and 0.32 mm. aluminum filter, so that on this basis the lower voltage should require 5.5 times as many milliamperes-seconds as the higher voltage to produce the same radiographic effect. Neeff does not report on the comparative radiographic effectiveness of these two radiations, but experiments in our laboratory show that body parts of medium tissue thickness, such as a chest radiographed with double screens, require about twenty-five times as much exposure at 50 K.V. as at 100 kilovolts. While it is not strictly fair to compare ionization measurements on one X-ray machine with radiographic tests on another, it is unlikely that the large discrepancy between the ionization ratio and the radiographic ratio of 50 K.V. and 100 K.V. radiations is due to the differences in the X-ray machines. It is fairly obvious then, that absorption coefficient, or effective wave length, alone is grossly inadequate as quality specification for radiographic purposes.

Column 5 in Table III gives the homogeneity coefficients of the radiations listed. It is to be noted that the homogeneity coefficients for radiations 3, 4, and 5 are the same within the errors of their determination. Thus the combination of absorption coefficient and homogeneity coefficient fails to distinguish between the qualities of the radiation of the Media and Metalix tubes at 50 K.V., with 0.32 mm. aluminum and 0.69 mm. aluminum filtration, respectively, and also fails to distinguish between these qualities and the quality of the Media tube at 70 K.V. and 0.18 mm. Al filter. Remembering that the absorption coefficients are the same for all the radiations listed in Table III, it would be expected that the homogeneity coefficients would show some systematic change with voltage on each tube, or with change of tube at the same voltage; however, these variations are rather erratic. The homogeneity coefficient is derived from the rate of change of the slope of the absorption curve, and under the conditions listed in Table III these slopes were changing rather rapidly. It was apparent to the writer, in determining these values, that they could be affected materially by errors of observation or slight variations in the way in which the curves are drawn through the points, as well as by the difficulties of accurate slope measurement. In fact, homogeneity coefficient is doubly affected by the various sources of error occurring in the determination of slope, since it requires a series of slope measurements on the absorption curve, from which a curve of slope plotted against filter thickness is drawn, and an additional slope measured on the latter curve. Under some conditions, the homogeneity coefficient may provide, with the absorption coefficient, a sufficiently definite specification of the radiation quality, but the above examples show that cases can readily arise in which it is inadequate for that purpose.

As for the absorption curves of Figure 4, no two of them are alike; there is no possi-

ble danger of one being confused with another. There are characteristic, systematic differences between the two tubes, and definite regular differences in passing from one voltage to another. Furthermore, it is not possible, by a variation of the voltage on one tube, to make its absorption curve agree with that of any one voltage on the other tube. Figure 5 shows a comparison of the curve for the Metalix tube at 77 K.V. (obtained by interpolation) with the Media curve at 70 kilovolts. These were adjusted to make the average slope of the curves the same between 1 and 4 mm. of aluminum, and the positions of curves are adjusted vertically to make them intersect at those filtration values. These curves do not differ much between 1 and 4 mm. of aluminum, but the difference is observable, and is still more marked at filtrations of less than one millimeter.

For radiographic purposes, the absorption curves should be determined for thicknesses of aluminum filter as high as 10 millimeters. It is apparent that at each voltage the curves (Fig. 4) of the two tubes become more nearly alike as filtration increases, so that for filtrations exceeding 2 mm. the radiation quality given by the two tubes is practically identical. Therefore, for the radiography of tissue thicknesses of filtration value greater than the equivalent of 2 mm. of aluminum, the quality of one tube can be matched by that of the other by operating them at equal or nearly equal voltages. For radiography of thin layers of tissue, the two tubes differ very appreciably in the intensity and absorbability of the radiation. It appears possible that for a narrow range of filtrations the operation of the two tubes, each at a suitable voltage, could result in effectively the same quality. But the complete absorption curve is required to tell the whole story, showing both the similarities and the differences in the different samples of radiation.

It was also found that the slopes of the

absorption curves of Figure 4 were difficult to determine reliably at very low filtrations, and rather erratic results were obtained, owing largely to irregularities in the experimental data. In the region of low filtrations, if a single thickness method of finding absorption coefficient is to be used, much more consistent results are obtained by the use of a finite thickness of filter than by the slope method.

It may be mentioned here that the slope measurements in this investigation were made with a semi-transparent mirror; at the point on the curve where slope is to be measured, the mirror is set at right-angles to the curve, as judged by the optical superposition of reflected and transmitted segments of the curve near the point of measurement.

INTERPRETATION AND USE OF THE ABSORPTION CURVE

Certain features of absorption curves may be interpreted quite readily. The steeper the slope, the softer and more absorbable is the radiation. The curves of both Figure 1 and Figure 4 show how the average slope of the absorption curve, and especially the slope in the more heavily filtered portion, decreases systematically with increase in tube voltage. Monochromatic X-rays give a truly straight absorption curve; and the degree to which the absorption curve approximates a straight line is a measure of the homogeneity of the radiation. The fact that at any one voltage the curves of the Media and Metalix tubes of Figure 4 have nearly equal slopes at the heavier filtrations indicates that the harder components of the radiation from the two tubes are similar, whereas the greater curvature of the Metalix curves at the lower filter thicknesses show that its softer component is less homogeneous than that of the Media tube, and that the Metalix tube emits a greater proportion of soft radiation than the Media

tube. These conclusions may be derived from inspection of the forms of the curves alone, without any knowledge of the voltages associated with the curves or the relative positions of the curves along the log I axis.

The close similarity in the wave length variation of absorption of X-rays by different materials makes it possible to derive simple relationships between the X-ray absorbing characteristics of different materials. For instance, 1 cm. of aluminum and 15 cm. of water have equal filtration values, that is, each one transmits the various X-ray wave lengths in the same relative intensities; while these two filters transmit the same quality of radiation (assuming equal incident quality) they do not transmit the same intensity, as the 1 cm. of aluminum transmits about 2.5 times the intensity transmitted by the 15 cm. of water. Thus from information of this sort, computed from well known spectral absorption data, it is a simple matter to derive the absorption characteristics of primary X-rays in one substance from a knowledge of their absorption in another, so that the absorption curve in copper or aluminum may be used to obtain information about the absorption of the same radiation in water or tissue. In large volumes of water or tissue, scattering affects the total X-ray intensity at any point very considerably. The scattering of X-rays in water phantoms has been investigated under a great variety of conditions so that such data, together with the absorption data, should make it readily possible to compute the total intensity distribution of any beam of X-rays in a volume of water, provided the quality of the incident beam is expressed by its absorption curve. Much more research will doubtless be necessary, however, to realize the full usefulness of the absorption curve in its application to the absorption of X-rays in body tissues.

The absorption curve is already used to some extent in reporting results of X-ray

intensity and quality measurements; an excellent example is given by Pohle and Wright (9), who have compared the X-ray output of two X-ray machines by means of the absorption curves (log I—filter thick-

absorption curve, especially over the greater filter thicknesses, and from the set of curves for the X-ray generator to find at which voltage a curve is produced having about the same average slope in the range of heavier

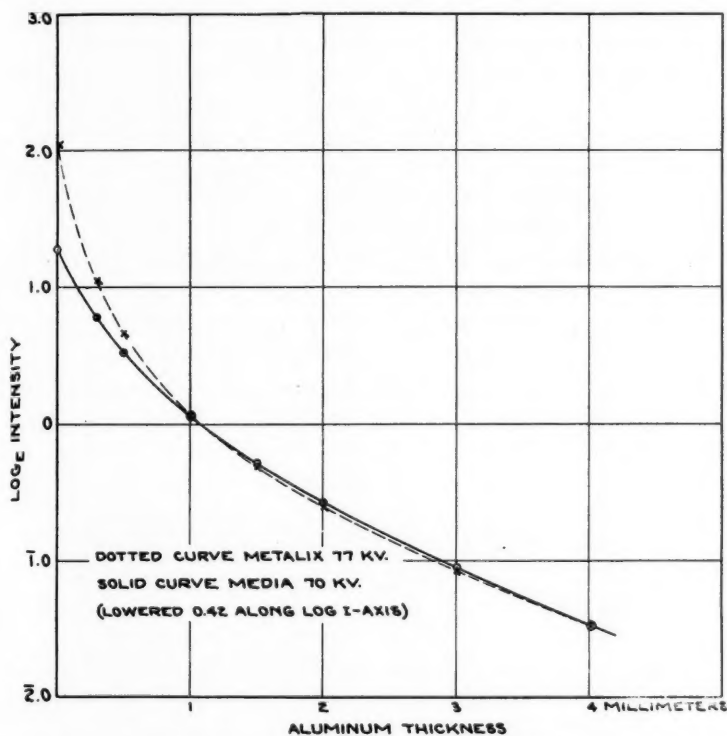


Fig. 5. Comparison of Metalix absorption curve at 77 K.V. with the Media absorption curve at 70 K.V. (from Neeff's data).

ness) obtained from each at various voltages. In the writer's opinion, there is no better way of describing the output of an X-ray generating apparatus.

In order to make routine use of this method of quality specification, the absorption curves of the X-rays produced by any X-ray generator should be obtained for the whole range of useful operating conditions. Then suppose it is desired to duplicate the radiation represented by an absorption curve provided by some other observer. The first step is to note the general slope of the given

filtrations. It may be necessary to interpolate between curves to find the voltage giving most accurately the desired value of this slope. If the radiation is to be used in the radiography of a thick part of the body, then so far as the radiographic result is concerned, it is the form and slope of the curve only for the greater filter thicknesses that need to be taken into account, and the same is true for heavily filtered high voltage radiation for deep therapy. If it is a question of superficial therapy with unfiltered radiation, then the whole absorption curve should

be matched as closely as possible. The selection of tube voltage will generally be governed by the average slope of the high filtration portion of the curve, while the duplication of the low filtration portion of the curve is apt to depend on the proper selection of the X-ray tube.

An unusually high output of soft radiation by a radiographic tube will indicate the necessity of filtration to avoid an excessive skin dose; usually 1 mm. thickness of aluminum will be sufficient in such a case. In fact, it is an excellent precaution always to use such a filter over a radiographic tube, as the effect of the filter upon radiographic exposure is slight, while the reduction in skin dose is considerable, especially with some tubes.

Of course, a certain amount of practical experience will need to be obtained with absorption curves in order to interpret them most intelligently, so as to be able to tell what sort of variations in the curve indicate effects due to the characteristics of the X-ray tube, or to the voltage wave form, and what forms are normal, and what are abnormal.

The correlation of the quality of the radiation with its biologic and radiographic effects should be much more systematic and intelligible by this quality specification than by other methods. Its advantages should be especially marked in superficial therapy, where little or no filtration is used, since in this case there may be large variations in the quality emitted by different X-ray tubes, and the accuracy of measuring this quality by the slope methods is very poor.

Another advantage of the absorption curve is that it offers the possibility of deriving quantitative information on the spectral distribution of X-ray intensity. Schwarzschild has shown the significance of the absorption curve in terms of the spectral intensity distribution, and Dr. L. Silberstein has recently worked out a practicable method of deriving the distribution of in-

tensity in various sections of the spectrum from the absorption curve,² thus making it possible to draw an approximate spectral intensity curve.

In the foregoing discussion it is understood that all X-ray intensities are to be measured in standard roentgens per unit of time. In order to obtain the absorption curves for quality specification it is necessary to have an instrument which will permit correct values of roentgens per minute to be determined over the necessary range of voltages and filtrations. A standard chamber is hardly suited for routine measurements in a roentgenologic laboratory, and the readings of secondary chambers are apt to deviate considerably from the standard chamber as the X-ray quality changes; this is especially true of instruments employing thimble type chambers. There is a genuine need for an X-ray measuring device which is simple, rugged, portable, easily read, and the indications of which can be translated into standard roentgens with but simple forms of correction for all useful qualities of X-rays. Some such instrument will be necessary if the measurement of X-ray intensities and the standardization and control of X-ray technic by such measurements is to become common practice in roentgenologic work. With this instrument the determination of the absorption curve would be a simple matter and could be carried out nearly as easily and as quickly as a reliable sphere gap measurement of voltage; in fact, it is quite possible that the calibration of X-ray generators by absorption curves would render measurement of tube voltage unnecessary.

SUMMARY

While the spectral intensity distributions of the various qualities of X-rays used in roentgenologic practice are of relatively simple type, they are not determined uniquely

²Not yet published.

by any single measurable factor, nor are they sufficiently uniform in character to be described by a single numerical specification.

It is shown from experimental data that the same effective wave length, or absorption coefficient, can be produced by a wide range of combinations of tube voltage and filtration, and that the corresponding radiations are not equivalent in their absorption and photographic effects.

The use of a homogeneity coefficient (derived from absorption data) in addition to the absorption coefficient, defines radiation quality more completely than the absorption coefficient alone, but its determination is rather involved for routine purposes; furthermore, any coefficients dependent upon slope measurements are subject to considerable error both in the measurement of slope and in the ways in which slope is influenced by errors in experimental data and personal judgment in fitting the curve to the data.

Absorption and homogeneity coefficients derived from experimental absorption curves (log I plotted against filter thickness) were found less capable of distinguishing between different radiation qualities than the absorption curves themselves.

The absorption curve (log I or $\log \frac{I}{I_0}$ plotted against filter thickness) is proposed as a general specification of X-ray quality for the following reasons: (1) It is uniquely related to the spectral distribution

of X-ray intensity; (2) it discriminates more accurately between different qualities of X-rays than other methods of quality specification; (3) it is certainly adequate to distinguish radiations having appreciably different absorption in tissue, and probably is amply precise for the distinction of quality variations which show measurable differences in biological or photographic effects; (4) it is a simple form of expression, avoiding complicated calculations; (5) the principal characteristics of the radiation can be interpreted readily by inspection of the curve; (6) other methods of X-ray quality specification, such as half value layer, absorption coefficient or effective wave length, and homogeneity coefficient may be derived from the absorption curve, (7) and further experience and research will make possible the derivation of additional information of value from such a curve.

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MEASUREMENTS OF EXTREMELY HARD ROENTGEN RAYS

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Translated into English by OTTO GLASSER, PH.D., Cleveland Clinic, CLEVELAND, OHIO

IT seems to be desirable from many physical and medical standpoints to be able to increase beyond the present limits the voltage which may be employed in roentgen therapy. This development is

circuit produces a pulsating, unidirectional current of sine wave form, as illustrated by Figure 2. The Villard circuit is especially suitable for this work because the high tension curve always returns to zero; then the

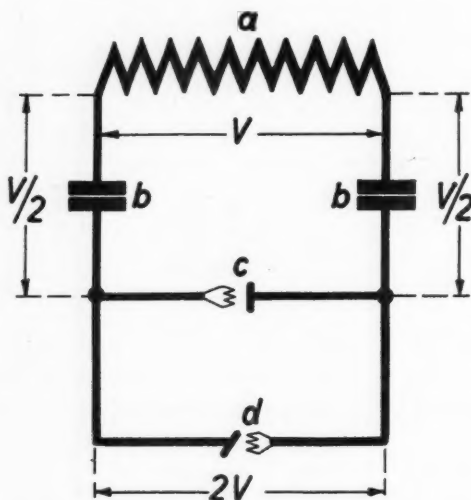


Fig. 1. Villard circuit: (a) transformer; (b) condensers; (c) rectifier tube; (d) roentgen tube.



Fig. 2. Tension curve of the Villard circuit.

given special encouragement because of the favorable results which have been obtained by the method of Coutard. Therefore, we wish to describe a roentgen apparatus which will generate voltages up to 400 K.V. and to present some measurements which were made of the radiation produced by it. This apparatus was developed in the laboratory of the Elektrizitäts-Gesellschaft Sanitas, of Berlin. The measurements were made in this same laboratory with instruments of the Physikalisches Reichsanstalt.

The circuit of this high tension apparatus has the Villard connection (1), the principle of which is illustrated by Figure 1. This

roentgen tube carries no load and any ionization which may occur in the tube is interrupted. Also, the self-induction in the secondary of the transformer tends to prevent any sudden increase of the tube current in case gas should be suddenly released in the tube. This conforms with numerous experiences in deep therapy in regard to the limit of potential which may be used, as it affects the life of tubes.

A schematic diagram of the apparatus is presented in Figure 3; Figure 4 shows the installation, at the Charity Hospital in Berlin, of a high tension generator which develops up to 600 kilovolts. The tubes are AEG therapy Type 3 (hard glass). It was learned that most of them could withstand up to 290 kilovolts. The voltage determinations were made by means of a 50 cm. sphere gap. It was found that if the voltage was increased beyond 290 K.V., a sudden "shock" occurred in the tube which was indicated by a coincident fluctuation of the pointer of the milliammeter. When this

happened the voltage was immediately decreased for a quarter or half an hour, until the tube would operate smoothly. After this procedure the voltage could be again in-

withstand voltages as high as 400 kilovolts. A tube once treated in this manner could afterwards be used with full voltage without another preliminary treatment.

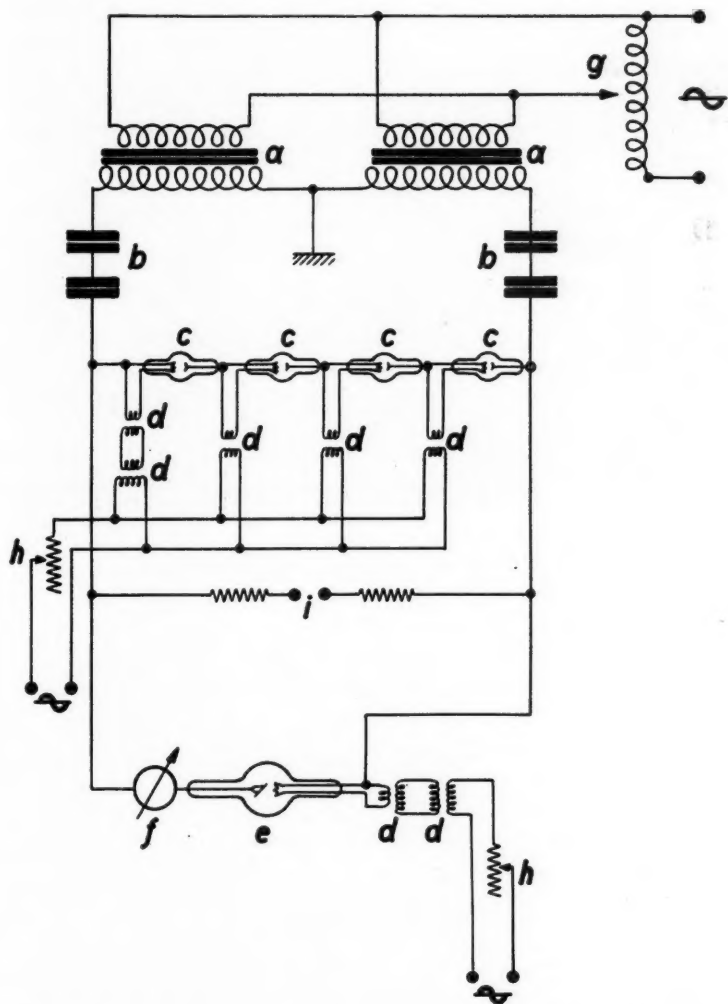


Fig. 3. Complete circuit of the roentgen apparatus: (a) high tension transformers; (b) condensers; (c) therapy rectifiers; (d) filament transformers; (e) roentgen tube; (f) milliammeter; (g) autotransformer; (h) resistances; (i) sphere gap (50 cm. diam.).

creased and the irregularity of the tube would disappear so that the voltage could be increased still more. Thus the tubes at our disposal could be gradually made to

It was possible to use a current of 0.5 ma. at 400 K.V., but if the current was increased the tubes became very irregular, probably because of the increased charge of

secondary electrons on the walls of the tube; however, at 400 K.V. and 0.5 ma., the tubes could be operated steadily and continuously.

addition to the indication of the peak voltage and filtration. We measured the half value layer in copper because this method is

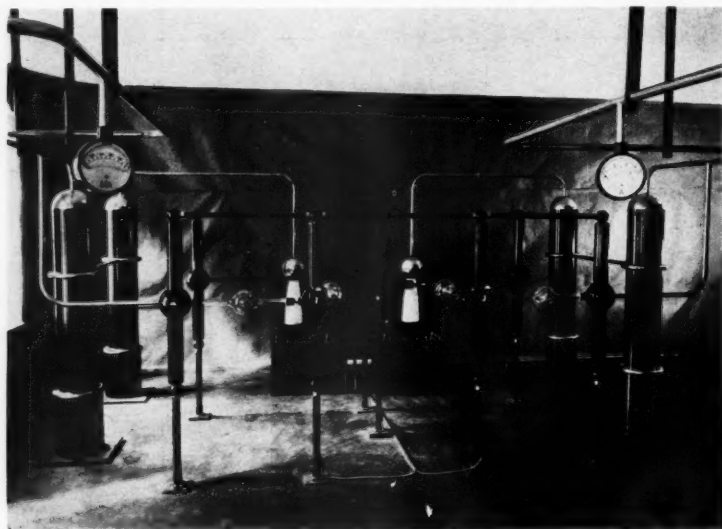


Fig. 4. Deep therapy apparatus for 600 K.V. "Gammavolt" of the "Elektrizitäts Gesellschaft Sanitas," Berlin.

One of our tubes has now been used for 100 hours without deterioration.

The radiation output at 400 K.V. and 0.5 ma. corresponds to that used in the usual treatment conditions at 200 K.V. and 4 ma., so that it will be just as economical. We may also anticipate that roentgen tubes will be improved in the near future so that higher potential and more current may be employed.

A series of experiments were made in order to investigate the character of the extremely hard roentgen rays which are produced under these new conditions.

HALF VALUE LAYERS

Measurements of the half value layer were made because this is a practical method of determining the quality of radiation in

generally used in deep roentgen therapy to determine quality. The measurements were carried out with a dosimeter equipped with a small ionization chamber and a uranium standard, the same type which was used by H. Behnken (2) in his determinations of the protective qualities of the metal tube. It is possible to determine 10^{-6} r per minute with this dosimeter. The sensitivity of the instrument was determined by a special condenser. Two identical condensers, the plates of one of which were covered with uranium oxide, were arranged so that they could be alternately connected or disconnected with the instrument, therefore, the total capacity of the measuring apparatus, with or without the uranium standard, remained unchanged. The ionization chamber of the dosimeter was independent of the wave length for hard roentgen rays. Figure 5

shows the calibration constant of the chambers. It is permissible both from a theoretical and a practical point of view to to extrapolate the curve to the hardness of radio-active radiations.

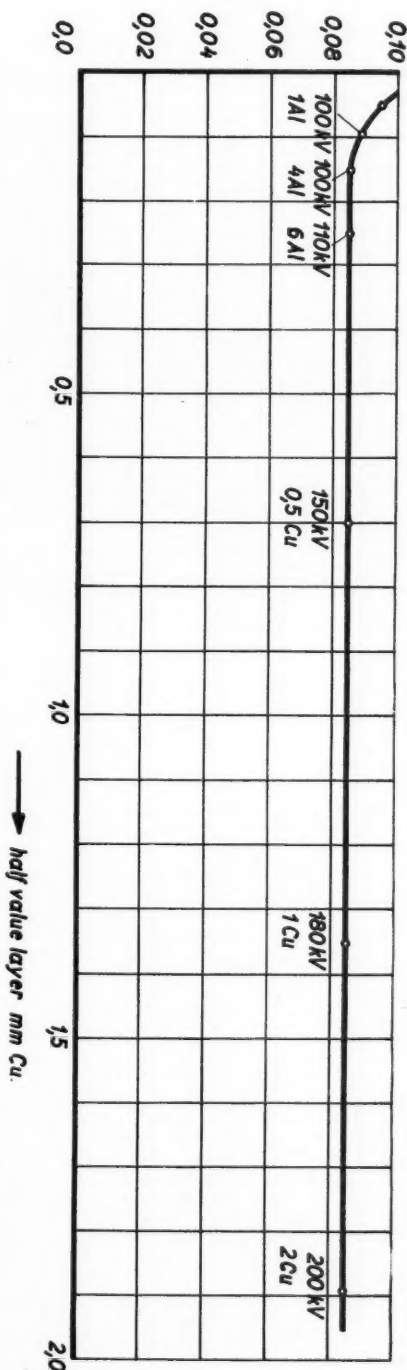
Figure 6 shows the relative position of the measuring instrument to the roentgen apparatus. The results of the measurement of the half value layer are illustrated in Figure 7. In order to control the measurements made with the sphere gap we have recorded the relationship of the radiation through 1 mm. of copper with the potential, and this relationship is explained by the curve of Figure 8. As may be expected, the curve shows that the hardness of radiation increases with the third power of the peak voltage. We find, for example, on the curve that at 400 K.V. and 0.5 ma. the intensity is the same as for 200 K.V. and 4 milliamperes.

DETERMINATION OF THE ABSORPTION IN LEAD

It is of special interest to compare the penetration of the roentgen rays which are produced at 400 K.V. with the radiation of radio-active substances. To make this investigation we carried out absorption measurements in lead because gamma radiation is usually indicated by its coefficients of absorption in lead.

The ionization chamber used in these determinations was placed in a lead container which had only one opening directed toward the roentgen tube. The results of these absorption measurements are illustrated by Figure 9, including the absorption curves at 204, 305, and 408 kilovolts, when the beams of radiation were filtered through 1 mm. copper plus 1 mm. aluminum. The curves show that for these qualities of radiation we can not determine an absolute coefficient of absorption for lead even through several millimeters. In order

Fig. 5. Dependence of the calibration constant k of the dosimeter upon the radiation quality $r/\text{sec.} = k \frac{\text{uranium seconds}}{\text{roentgen seconds}}$.



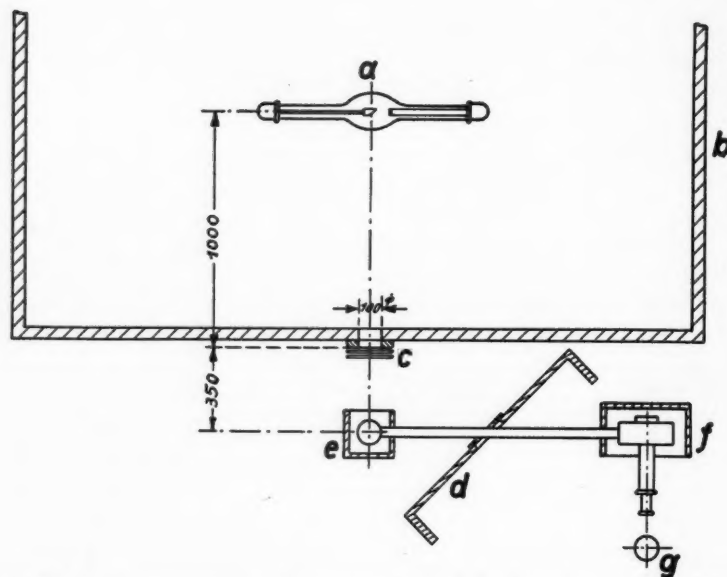


Fig. 6. Arrangement for the measurement of the intensity: (a) roentgen tube; (b) lead drum; (c) diaphragm and filter; (d) lead screen; (e) ionization chamber; (f) dosimeter; (g) observer.

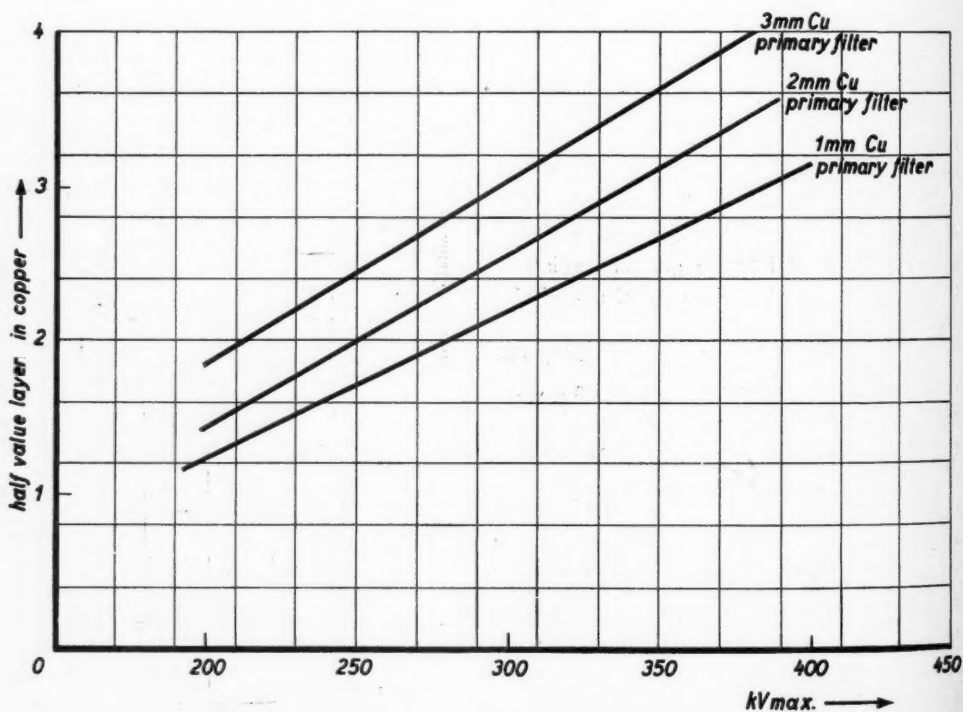


Fig. 7. Half value layers in copper.

to obtain a better idea of the change which occurs by increasing thicknesses of lead, we attempted to determine the coefficients of weakening for every half-millimeter of lead, and these results were noted in relation to the thickness of lead employed. As can be

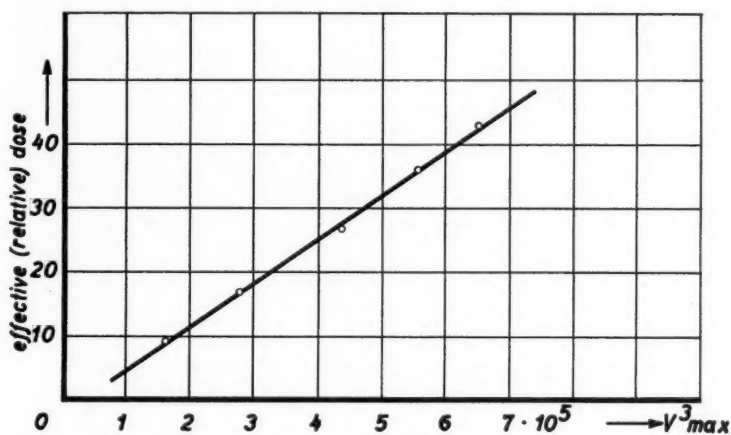


Fig. 8. Dependence of the effective (relative) dose upon the third power of the peak voltage.

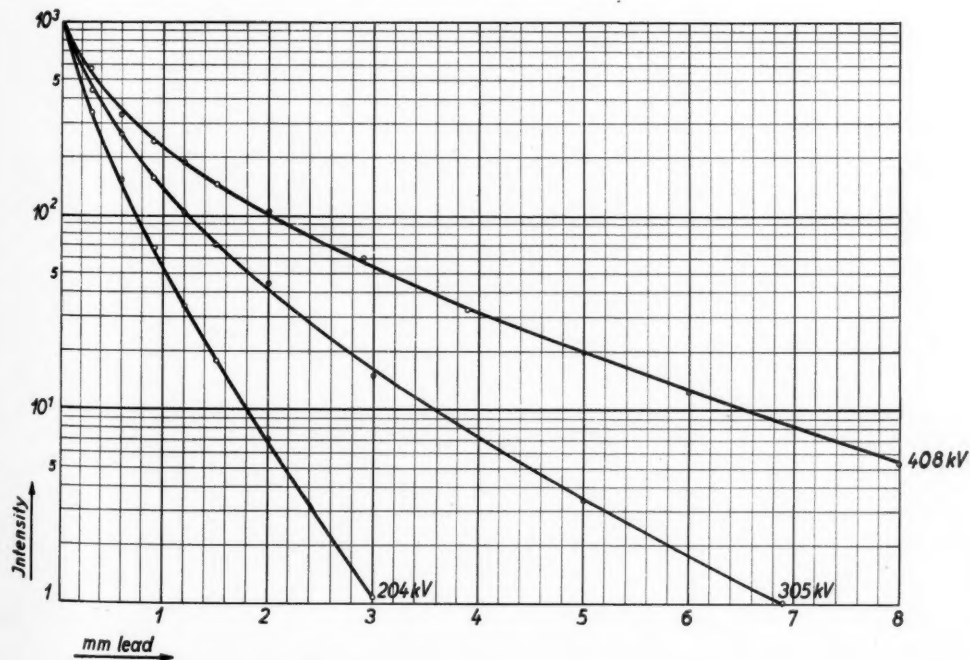


Fig. 9. Absorption curves in lead. Primary filter: 1 mm. Cu + 1 mm. Al.

seen from Figure 10, the differential curves of weakening in lead did not show a final value, at least for 300 or 400 kilovolts.

These results were compared with the values given by Glocker and Reuss for the coefficients of weakening through 3 and 4 mm.

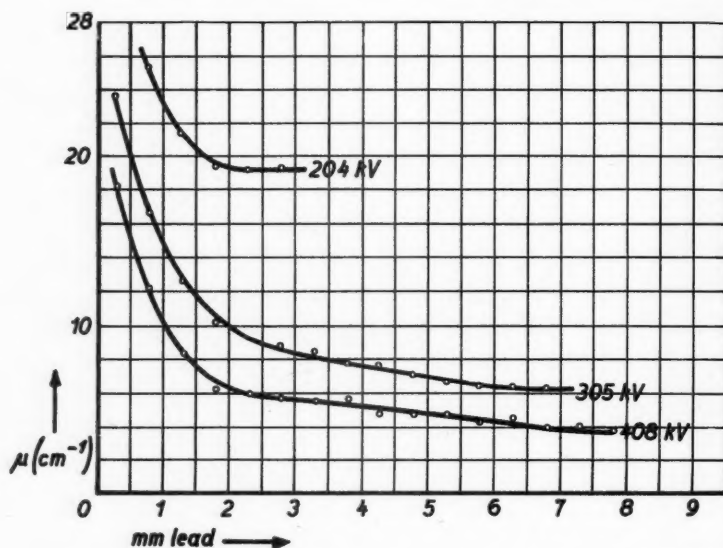


Fig. 10. Coefficient of weakening (cm^{-1}) as a function of the primary filter, for each $\frac{1}{2}$ mm. of lead.

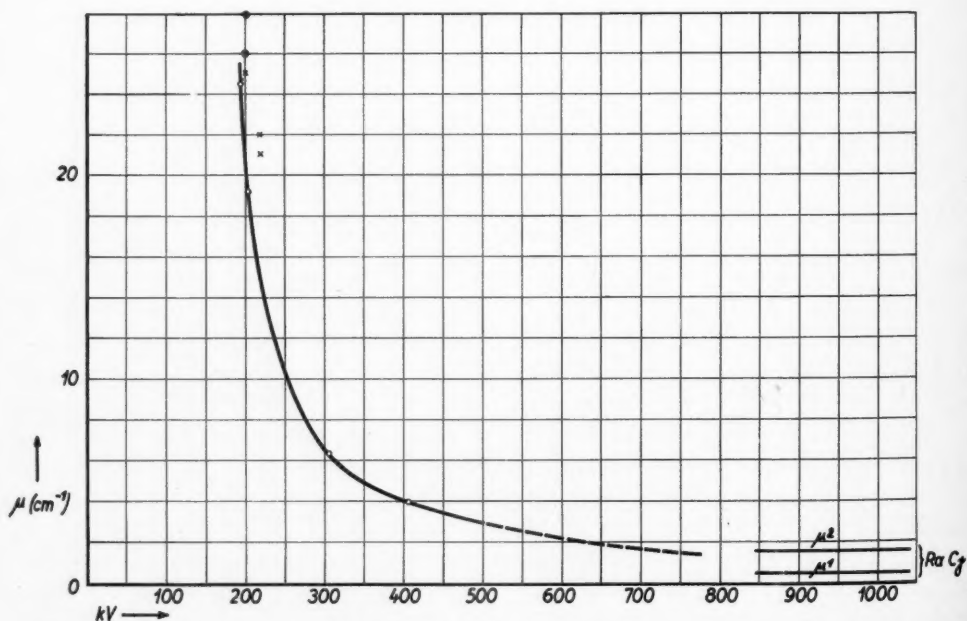


Fig. 11. Coefficient of weakening (cm^{-1}) of lead for various voltages at the tube. \odot Kaye's values; $+$ Berthold's values; \circ authors' values.

of lead, but we also determined the coefficients of weakening and their relationship to the voltage when using 3 mm. of lead at 300 K.V., 7 mm., and 8 mm. of lead at 400 K.V., these relationships being shown by

previously mentioned, and they also have practically the same value between 100 and 200 K.V. but show a definite decrease beyond 200 kilovolts.

In order to determine the thickness of

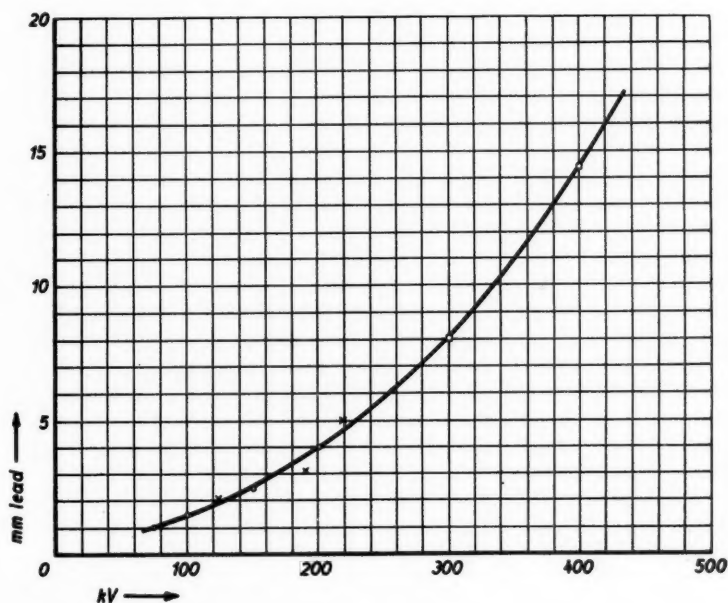


Fig. 12. Protective layer of lead for various voltages at the tube: + German protective standards; O English protective standards; □ lead thickness of a protective value equivalent to 5 mm. at 200 kilovolts.

Figure 11. The value which we obtained at 200 K.V. agrees with that of Glocker and Reuss (3). Also the drop in the curve which was noted by these authors is illustrated very well, as the curve extends toward the harder radiations and it can be seen that the coefficient of weakening at 400 K.V. approximates that which has been determined for the two components of the gamma radiations from radium "C" (4). The absorption curves for lead can also be obtained from the curves which were given in the paper by H. Behnken which was pre-

lead which would be necessary to afford complete protection for these hard roentgen rays we have used as our basis the English standard requirements of 4 mm. of lead for 200 kilovolts. If this value is accepted, by the application of the curve in Figure 9, we find that the ratio for the weakening effect is as 1 to 10,000. If the same weakening effect is desired for 300 or 400 K.V., then a thickness of 8 mm. is required at 300 K.V. and 14½ mm. at 400 kilovolts. The curve in Figure 12 shows these values and that the thickness of lead

which would be required for protection according to German and English requirements falls well within the curve of these figures.

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ATOMS COMBINE IN SUN'S ATMOSPHERE

Not all chemical compounds break up in the intense heat of the sun's atmosphere, Prof. Henry Norris Russell, of Princeton University, recently told the meeting of the National Academy of Sciences.

It was formerly supposed that no chemical molecules could form in the sun. Fourteen different compounds have now been discovered there, six in the photosphere or out-

er layer and eight more above the darker sunspots.

Hydrogen and oxygen occur most frequently in these compounds, hydrogen being the most abundant constituent of star atmospheres. As the behavior of the substances is well known on the earth the extent of their dissociation in the sun and stars can be calculated with some accuracy. The results are in good agreement with observation.—*Science Service*.

THE RELATION OF THE DIAPHRAGM TO GASTRIC PERISTALSIS¹

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Department of Roentgenology, Grant Hospital, Chicago

IN a previous study² we have noted that the diaphragm has a definite influence on the opening and closing of the cardia. Because of the peculiar sphincter-like structure of the pillars, the diaphragm induces a milking-down contraction which can be felt by inserting a finger into the gastro-esophageal opening through a gastrostomy. By examining the human subject under the fluorescent screen one can detect the terminal point of this milking contraction, manifested by a complete closure of the cardia during inspiratory contraction of the diaphragm. This closure is sufficiently watertight to prevent a barium meal from passing through and thereby causing an accumulation of barium at the cardia, much in the manner of cardiospasm. Coincident with the elevation of the relaxing diaphragm, the pillars also relax, thus allowing the barium meal to pass through the cardia into the stomach. These observations led us to believe that the diaphragm, although primarily a muscle of respiration, exerts a very important influence on the abdominal as well as the thoracic organs.

In the course of our observations on the diaphragm as it affects the cardia, we noticed that the fundus of the stomach ascends and descends along with the diaphragm. It is extraordinary that such a phenomenon should occur in the fundus, especially since we know that there is no definite anatomical attachment between the abdominal surface of the diaphragm and the roof of the fundus.

It is possible that the diaphragm exerts a definite suction on the fundus, so that, as it goes up, it pulls the fundus with it. This phenomenon is noticeable in the upright as well as the recumbent position. The amount of gastric distention or the degree of gastroptosis has little or no bearing on the *ascensus* and *descensus* of the fundus.

Coincident with the changes of the fundus in the vertical plane there are changes occurring in the horizontal plane. As the fundus descends, one notices definite constriction of the upper portion and a dilatation in the lower portion that corresponds with the midgastric portion of the stomach. This is what apparently happens. The portion of the stomach below the level of the incisura angularis is more or less fixed, so that it does not go up and down with the diaphragm, an apparent fixation which causes the stomach to act much like a distended toy balloon. When the upper portion of the balloon is compressed by virtue of its elasticity the balloon expands at its lower portion: the contrary occurs when the upper portion is pulled up. Similarly we have in the stomach a muscular wall capable of distention and contraction. The moving diaphragm exerts upon the fundus a positive pressure of from ten to twenty-five millimeters of mercury. The stomach which is distended with food or fluid is now further influenced by the contracting diaphragm, so that the upper portion of the fundus appears somewhat constricted and the lower part appears dilated. As the diaphragm goes up during expiration it sucks or pulls with it the upper portion of the fundus, which now dilates, while the midgastric area becomes con-

¹Read before the Radiological Society of North America at the Sixteenth Annual Meeting, at Los Angeles, Dec. 1-5, 1930.

²M. Joannides: Influence of Diaphragm on Esophagus and on Stomach. Arch. Int. Med., December, 1929, XLIV, 856-861.

stricted much in the manner of the toy balloon. The roof of the fundus and the colon, as well as the abdominal wall, exert also a definite pressure. The action of the colon appears very much like the kneading of dough when it is done with the palm of the hand. After a series of these contractions, small waves begin to appear in the lower portion of the fundus, and one of these initiates a typical peristaltic wave along the greater curvature, beginning at the level of the incisura angularis. When this peristalsis is initiated the wall on the lesser curvature appears to contract, and the antrum now draws into a circular form which is seen to travel towards the pylorus.

In addition to the changes in the form of the stomach we have also certain changes in intragastric tension. From our previous observations we know that the cardia closes with each inspiration so that even milk with barium cannot pass through. At this moment the diaphragm descends and in so doing exerts a definite pressure on the stomach, resulting in an increase of intragastric tension which involves the whole stomach. This tension has a tendency to dilate to a greater or less extent not only the midgastric portion but also the antrum, a phenomenon which is particularly noticeable in the stomach of asthenic subjects. In these individuals there is quite a distinct circular expansion of the antrum and the prepyloric area during each inspiration. It is common knowledge that increased tension in the gastro-intestinal tract will induce peristalsis.

Other factors of great importance are the automatic and rhythmical action of the non-striated muscle of the digestive tract. Alvarez and his co-workers³ have demonstrated that the non-striated muscle of the gastro-intestinal tract is capable of rhythmic contractions under conditions uninfluenced by the nervous mechanism. He has shown that this muscle has a gradient of

rhythmical action and that this gradient has a ratio of eleven contractions for the cardia against two contractions for the pars pylorica. Alvarez has also noticed evidence of high automaticity in the lesser curvature next to the cardia. He says:

We see that local peculiarities in the muscle, with graded differences in rhythmicity, irritability, tone and latent period, probably have most to do with directing the peristaltic wave as it travels over the stomach. As in the heart, so here, the waves probably have their origins in the most highly rhythmic and sensitive area. We may say perhaps that the region on the lesser curvature next to the cardia is the pacemaker for the stomach. It must be remembered, however, that the cavities of the heart and stomach are very different. In one, the impulse travels so rapidly that the organ appears to contract as a unit; in the other, a series of waves travel slowly over the sac, gently kneading its contents.

Alvarez has also shown that there is a difference in the type of contraction of muscle fibers from the fundus and the pars pylorica—contractions of greater amplitude in the pars pylorica than in the fundus. McCrea, McSwiney, Morison, and Stopford⁴ have also noticed in cats, rabbits, and dogs that the waves which began near the cardia, spread downward, producing a constriction ring at the upper end of the pars pylorica, then a bulging of the pyloric portion and finally a concentric contraction ring of that region. This contraction, relaxed as a new wave, arrived at the incisura. These facts demonstrate that a wave initiated in the cardia and fundus is conducted down to the pars pylorica.

It is plausible to assume that the diaphragm is fundamentally a factor in the initiation of these peristaltic waves, since we know that, as it contracts and expands at

³Walter C. Alvarez: *Mechanics of Digestive Tract*. Second edition. P. B. Hoeber, Inc., New York, 1929.

⁴E. D. McCrea, B. A. McSwiney, J. W. Morison, and J. B. Stopford: *Normal Movements of Stomach*. *Quart. Jour. Exper. Physiol.*, 1924, XIV, 379-397.

least twenty times per minute, it also opens and closes the cardiac region, the most sensitive portion of the stomach. Moreover, the pillars exert a milking-down contraction on this region, thus instituting downward impulses in this area. The peripheral portion also, with its *ascensus* and *descensus*, not only changes the intragastric tension but also aids in the contraction and expansion of different parts of the fundus. These contractions and expansions undoubtedly set up action-currents which are carried downward both by the muscle fibers and the nervous mechanism of the stomach.

Some additional data may be of value in this connection. Orndoff⁵ has observed definite differences in the contraction of the diaphragm when the subject is asleep. He says:

In a perfectly natural unmolested sleep, fluorescent screen observations have convinced me that the action of the diaphragm is exceedingly limited and does not consist of the rhythmic excursion noted during other periods while the patient is awake. The change in chest volume, accounting for the same type of respiration, seems to be due entirely or nearly so to the movement of the ribs. On waking up, there is almost always a long inspiration, during which there is noted a full contraction of the diaphragm, with a maximum amount of motion of the subdiaphragmatic viscera, and immediately the usual excursion of the diaphragm is noted with each inspiration.

From this observation we can assume that the diaphragm exerts little or no influence on the stomach during sleep. As soon as the patient awakes and breathes normally the impulses are again sent down to the cardia and the rest of the stomach. Alvarez⁶ has shown that "after a long rest the smooth muscle of the gastro-intestinal tract seems

to get on a hair trigger, so that it will respond powerfully and explosively to a slight stimulus." He states further that this "is the condition of the digestive tract after the night's rest, and it probably has much to do with the fact that most of us have the daily bowel movement in the morning immediately after breakfast." The explanation of this phenomenon is now obvious. The diaphragm, after its nightly rest, is working again, urging the highly sensitive cardia to induce peristalsis. Breakfast is taken and the intragastric tension is increased. The peripheral end of the diaphragm is now ready not only to press the fundus up and down and thus by intermittent changes in the tension to induce peristalsis in the pars pylorica, but it mobilizes its allies, namely, the abdominal wall and the colon, to do their share in kneading the fundus so that peristalsis shall begin.

Just as in the heart where we have many factors influencing the contractility, rhythm, and conductivity of the muscle, likewise here we have several factors which influence the gastric muscle. We must keep in mind also such other factors as psychic shock, hunger, training of the digestive tube, nerve impulses arising in the central and peripheral nervous system, secretory activity, physical changes such as heat and cold applied either externally or internally, hormone activity, and the quantity as well as the quality of the contents in the stomach and intestines. Giving full value to all these factors, yet we must not lose sight of the fundamental mechanism in the muscle itself as influenced by the constantly working diaphragm.

The subjects used for this study were normal adult males and females including hypersthenic, sthenic, and asthenic types. Both the upright and reclining positions were studied. Permanent records of these observations were obtained by means of a seriograph devised to obtain four consecutive films within eight seconds. In our

⁵B. H. Orndoff: Personal communication.

⁶Walter C. Alvarez: *Mechanics of Digestive Tract*. Second edition. P. B. Hoeber, Inc., New York, 1929, p. 23.

observations the subject was made to inspire, hold his breath, and, as soon as the film was exposed, to expel, and again hold his breath. After a few deep breaths the other two exposures of an inspiration with its subsequent expiration were made. The amount of opaque meal given depended on the degree of distention we desired to produce on the stomach.

CONCLUSIONS

This and previous studies of the diaphragm demonstrate that although primarily

a muscle of respiration, it has a definite extra-respiratory function. It induces an opening and closing of the cardia. It produces a milking contraction on the cardia in the region of the stomach that is most automatic and is in the highest degree rhythmic. It compresses and lifts up the fundus and, in so doing, not only changes the form of the stomach but also influences the intragastric tension. One may assume, therefore, that this muscle plays an important rôle in the initiation and maintenance of peristalsis in the stomach.

RARE ELEMENT GIVES NEW KIND OF LIGHT

Rods of quartz heated in the Bunsen burner have been made to send out a new kind of light, the meeting of the National Academy of Sciences has been told.

The quartz, in which a compound of the rare metal neodymium had been dissolved, was prepared by Prof. R. W. Wood, of Johns Hopkins University. When heated, the rods give a light whose rainbow or spec-

trum does not include all the colors but is crossed by dark bands.

A white-hot, incandescent wire, like the wires of tungsten used in the electric lamp, gives white light in which none of the possible colors are missing. The neodymium, however, has the unique property of sending out only special vibrations of its own. Light passed through cold neodymium or other rare earth compounds has these same colors removed from it. No other substance shows this behavior.—*Science Service*.

TRAUMATIC LUXATION OF THE COCCYX¹

By CARL S. OAKMAN,² A.B., A.M., M.D., MUNCIE, INDIANA

THE patient whose case introduces this paper, a Mr. E. H., white, aged 55, married, a foundry worker, weight 150 pounds, sustained an injury to the coccyx on May 25, 1929. In the course of his duties, he fell from a step-ladder, landing on his buttocks on a wooden box, a corner of which directly struck the coccyx. He experienced immediate pain and was referred to the company physician, who found, the following morning, by rectal examination, an unevenness of the anterior surface of the coccyx, and pain upon pressure, both externally and in the rectum. He diagnosed a dislocation and referred the patient to me for roentgen examination. Lateral projection revealed a forward luxation of the first coccygeal segment, which was displaced a distance almost equal to its own thickness, the rest of the coccyx being symmetrically curved. The outlines of the upper coccygeal and the last sacral element indicated that no bony fusion had existed and the remaining segments showed distinct spacing, as if separated by cartilage. The antero-posterior view gave no hint of the luxation, but showed a vertical line in the first segment that was suspicious of fracture, without displacement. The cornua were not visible; the transverse processes were very rudimentary. Four coccygeal segments were plainly registered, the distal one possibly representing a fusion of two rudimentary elements. The contour of the sacrum and coccyx described a normal curvature, except for the luxated first segment, and there was no lateral deviation.

On May 27 the attending physician reduced the dislocation, by intrarectal digital

pressure, with the patient in a kneeling position. Bowel movements were painful for only a few days, but for three or four weeks the patient complained of an aching sensation. He resumed work in eight weeks.

On October 5 he was referred for another roentgen examination, at which time he said he was free from all pain and ache, except after long automobile rides. Digital examination was painless. The roentgen films showed the same luxation of the first segment, with apparent callus formation anteriorly at the sacrococcygeal junction.

Medical literature shows few and brief allusions to roentgen examination of the coccyx. Careful search failed to reveal any article in roentgenologic journals, and the text-books give little or no information. George and Leonard (1), in their recent volume, illustrate a case of anterior luxation. Jones and Lovett (2) say: "X-ray may or may not be reliable in this region and the antero-posterior view shows only lateral displacement. To obtain satisfactory definition in a side X-ray is, of course, difficult, but often possible with a highly perfected technic." Letters written to 94 roentgenologists brought few helpful replies.

Coccyx (plural *coccyges*) is a word derived from the Greek, meaning a "cuckoo," probably because of a fancied resemblance to a cuckoo's beak. The German equivalent is "Steissbein" and the French is identical with the English. Colloquially, it is called the "tail bone" or "crupper bone." It is a small bone of variable length, forming the caudal extremity of the spine, but destitute of a canal. It comprises four or five segments (rarely three or six), of which the first is the largest and shows some rudiments of the structure of a sacral segment, while the others dwindle into successively smaller

¹Read before the Radiological Society of North America at the Fifteenth Annual Meeting, at Toronto, Dec. 2-6, 1929.

²Dr. Oakman died before proof of this paper could be submitted to him, so that it is unknown what changes he might have made.

and characterless nubbins of bone (vertebrae caudales). Piersol (3) says that data concerning ossification are very unsatisfactory. Each segment has one center, the first may have two; ossification begins in the first piece near birth, and successively later in the others, up to puberty. The first segment presents two cornua, projecting up posteriorly behind the posterior surface of the sacrum; it also presents two rudimentary transverse processes. Both the cornua and the processes are variable, sometimes being well-formed and either rugged or slender, and sometimes being hardly more than tubercles. The first segment is somewhat wedge-shaped, and has greater breadth than length or thickness; it is sometimes asymmetrical. The entire coccyx is usually more rugged in the male than in the female.

The apices of the sacrum and of the first coccygeal element are connected by fibrocartilage, and a few unimportant ligaments. This synchondrosis sometimes shows osseous fusion, and the distal segments also may fuse. Gray (4) says that the last three segments are usually fused with one another, and the last may be bifid; complete ankylosis is likely to result in fracture in the event of trauma. Bony fusion occurs often in the male, and usually at an earlier period.

Variations from the normal curve of the coccyx are common; lateral deviations are very frequent, but apparently never productive of symptoms; exaggerated forward curve is frequent and occasionally impinges on the rectum and produces trouble; the rarer posterior curving may project beneath the skin and induce pressure changes. Absence of the coccyx has been reported (5). One hears occasionally of human beings with a coccyx developed into a true tail, but no authentic report is discoverable in medical literature.

Muscles are attached as follows, according to Buchanan (6): The gluteus maximus

to the back of the upper three segments, close to the lateral border; the sphincter ani externus to the tip; posterior fibers of the levator ani and a portion of the coccygeus to the lateral borders.

The junction of the sacrum and coccyx completes the fifth posterior sacral foramen for transmission of the posterior division of the fifth sacral nerve. No nerves emerge from the coccyx below this. The coccygeal plexus is composed of the fourth and fifth sacral nerves (except the visceral branch of the fourth anterior sacral), the coccygeus (anterior and posterior branches), and probably the inferior hemorrhoidal branch of the internal pubic. On the anterior aspect of the coccyx are two ganglia (Luschka's gland), belonging to the pelvic sympathetic system. These ganglia are united to each other by a small filament and are connected by other filaments to the last sacral ganglion of the chain forming the pelvic sympathetic (Hamant and Pigache, 7). Jointly these nerves supply sensation to the integument over the coccyx, around the anus, and the intervening area, and innervate the levator ani, sphincter ani, and coccygeus muscles.

The subject of dislocation of the coccyx has had much discussion in the past. Stimson (8) says that descriptions given by earlier writers were questioned in the early part of the twentieth century, and quotes Boyer as maintaining that the lesion never occurred; the matter was somewhat connected with coccygodynia, as cause and effect, but the actual occurrence of dislocation was well enough attested by several reports, mentioned by Stimson (Malgaigne, Roeser (9), Bonnafont (10), Mouret, 11), and also reports by Skene (12), Cyriax (13), Jones (14), Gehrung (15), Drueck (16), Petit (17), and Hirst (18). Undoubtedly some of the cases reported as dislocation were really displacements due to fracture, and the converse may be true. Practically none of the reports include roentgen evidence, many

of them having been made prior to Roentgen's discovery, and subsequent writers largely ignore its application in lesions of the coccyx. An article by Cyriax (13), in 1922, covers the clinical diagnosis, but does not allude to the X-ray. Several of the roentgenologists with whom the writer has corresponded stressed the point that X-ray examination is unnecessary, because the diagnosis by clinical means is so simple.

Several writers mention that dislocation is commoner in women than in men, because the intersegmental cartilages persist longer and allow displacement instead of fracture, and because many of these displacements occur at parturition: Hirst (18) also attributes man's relative immunity in part to the higher position of the coccyx and the closer approximation of the ischia; he states that during labor there is backward stress on the coccyx, sometimes producing rupture of ligaments, dislocation, or fracture. If displacement occurs, it is posterior, whereas direct external violence produces anterior displacement. Speed (19) says, regarding birth trauma: "Whether there is a true fracture at the sacrococcygeal junction or a stretching of the ligaments which permits the displacement, it is not always possible to decide, even with the help of a roentgenogram." Jolly (20) reported a unique case of escape of the distal segment of the coccyx through the anus ten days after childbirth. Cyriax (13) refers to displacements of the coccyx on the sacrum (*i.e.*, at the sacrococcygeal joint) but has never seen one distal to this point; he says that minor displacements seldom occur after middle life, due to the fact that the sacrococcygeal joint has united, although Piersol (3) states that it is not uncommon for the first segment to remain separate, without fusion to the sacrum or to the second segment.

Outside of birth injury, there is very rarely a posterior luxation of the coccyx. Injuries by direct violence, producing fracture or luxation, practically always show an-

terior displacement. The usual causation is a fall or a kick. Displacement of the coccyx may or may not be accompanied by tilting, or rotation, or both. Cyriax (13) reports cases of luxation due to rheumatic fever, straining at stool, pelvic cellulitis, and sudden effort to prevent falling. He thinks some cases are perhaps due to over-use of the sitting position, by which the coccyx is gradually pushed forward. The chronic sitters were mentioned by Ramsbotham (21) in 1851, who said: "Ankylosis often occurs in women who have been accustomed to sit the principal part of the day, as is the case with milliners."

The symptoms of a recently luxated coccyx are: (1) Pain, aggravated by defecation, sitting, riding, coughing, walking, and coitus, often causing the victims to sit sidewise and to shift position constantly; (2) impairment of bladder function (Speed, 19); (3) constipation, usually due to postponement of stool. Further and diverse symptoms may develop after the lapse of time, which will be discussed under a later heading.

Physical signs of a recent case include: (1) Tenderness on pressure externally or by rectum; (2) ecchymosis or other signs of bruising, though Cotton (22) says that ecchymosis is rare; (3) deformity, which may or may not be visible, and is usually detectable by palpation, either externally or by rectum, or both; (4) mobility of the displaced coccyx.

It may be difficult to differentiate between a fracture of the coccyx and a dislocation. The literature gives scant discussion to this point, and there is reason to believe that errors have been made. The existence of crepitus is by no means universal in fracture cases; probably fracture affects the proximal segment far oftener than it does all the others. An ankylosed coccyx is much more likely to suffer fracture than a jointed one.

If a physician sees a case of injured

coccyx long after the accident, diagnosis may not be so easy, and he is apt to fall back on the convenient term "coccygodynia." This is the word that has been in turn respected and later condemned. In 1859 Sir J. Y. Simpson (23) published his article, describing the cases of persistent pain in the coccyx, and dignified the condition as a separate entity under the term "Coccygodynia," a word which "caught on" and had long years of popular use. His description has hardly been improved upon, since he had a good understanding of the various kinds of pathology that may underlie it. He discovered early reports of coccygeal injury, including those by Smetius, sixteenth century, and Van Meeren and Gahrlied in the seventeenth. Simpson did tenotomy for relief of his first cases, but later did resection. However, the credit for the first resection must be given to Nött (24), of New Orleans, whose report appeared in 1844, describing a case of "neuralgia" from caries. Prior to this, in 1841, Blundell (25) had suggested the operation. Simpson inspired Scanzoni (26) to devote twelve pages to the subject in his text-book, published in 1861, and laid the foundation for what amounted almost to a fad for coccygectomy. However, the pendulum swung after a few decades, when it was found that this procedure was not uniformly successful, and we find Beach (27), in 1899, saying that resection in chronic cases of pain is "an operation notably unsuccessful." In Cotton's work (22), 1924 edition, appears the statement: "Most of the cases, even when there is a history of some injury, are essentially localized symptoms of a psychosis, 'hysteric,' as we name these localized psychoses. In such cases operation will not help the patient and will only discredit the operator." Meanwhile, it has been shown by various writers—C. Beck and V. S. Cabot (28), Gant (29), Hirst (18), Werner (30), Smith (31), Tillaux (32), Whitead (33), Blount (34), Boland (35), Tédénat and Simesaël (36),

and Dinnendahl (37)—that resection is justified in certain cases of injury, tuberculosis, caries, periostitis, etc. It is claimed that no weakness or perceptible defective function ensues after resection. The interest in coccygodynia and in operative relief was for a long time maintained chiefly by the gynecologists and proctologists, while the general surgeons eschewed it.

In 1914 Yeomans (38) reported a new method of treatment by injections of alcohol at the site of pain. An article had appeared on the same subject by de Vézian in 1907 (39). The successful use of the faradic current by Seeligmuller and Grafe was mentioned in the 1904 edition of von Bergmann's "Surgery."

Some of the gynecologists in the past have been inclined to ascribe coccygodynia in certain cases to metritis, salpingitis, prolapsus uteri, prostatic disease, hemorrhoids, fissure, rectal tumor, etc. Hamant and Pigache (7), 1914, in a critical study, deplored this inclination. Yeomans (40), 1919, classified some cases as "symptomatic," or referred pain, due to disease of the central nervous system, such as hysteria, neurasthenia, irritable spine, traumatic neuroses, tabes, toxemia, and "habit pain."

In passing, it should be mentioned that the original term "coccygodynia" gave way to "coccygodynia," which was substituted because it is etymologically more precise. Colloquially it is variously known as "neuralgia of the rectum," "rheumatism of the rectum," "elongated spinal column" (Drueck) (16).

It seems to be fairly well agreed that the most common cause of coccygodynia is injury, either recent or remote, severe or mild, single or repeated. Stimson (8) thinks that dislocation and fracture are commoner than the reports indicate. Cyriax (13) stresses minor displacements and the subsequent occurrence (in either major or minor degree) of synovitis in the sacrococcygeal joint, adhesions, periostitis, periarticular thickening,

and irritation of sensory nerves through disturbance of the coccygeal ganglion. Hirst (18) remarks that after injury the lesion has a poor chance to heal, because of stress in all the usual activities of life, especially defecation, sitting, and rising.

The case report at the beginning of the present article shows so well the value of precise knowledge, as furnished by roentgen examination, that it needs no argument to urge the more widespread use of this method. Clearly, the lateral view is required, and with modern refinements of technic it ought to be possible to obtain such views in all cases of suspected injury. It is true that the interpreter must guard against being deceived by the anatomical variations, but I have seen in the literature no mention of variation that simulates true luxation. The recorded variations include lateral deviations and increased angulation, either forward or backward. In antero-posterior projections centering over the pelvis, such as are taken for any bony pathology in this area, or for the lower part of the urinary tract, there is always an image of the coccyx. The variations in contour, length, number of segments, ossification, and deviation from the midline have been noted by every one, but it is well known that luxation practically never occurs laterally, so that error in that respect can hardly occur. A series of lateral projections on healthy subjects was recently made by the writer, and there was found to be great divergence in the degree of curvature, but nothing resembling a dislocation. These anomalous curvatures show an intact sacrococcygeal joint, and intact intersegmental joints, whereas a luxation will show an abrupt irregularity at some one of these joints in the lateral view. In films loaned by Dr. H. B. Podlasky the antero-posterior view showed an over-lapping of the first and second coccygeal segments that seemed quite positive evidence of dislocation. No lateral view was taken. It seems probable that dislocation may occur oftenest at the sacro-

coccygeal joint, but no reliable data are available, because the exact point of dislocation is rarely mentioned in reports, or, if it is, the opinion is based on physical examination, and X-ray evidence is never quoted. Those injuries which, upon roentgen examination, show abrupt and pronounced angulation, sometimes as much as 90 degrees, but little or no slippage at the joint, are very puzzling, because some normal coccyges show similar angulation. Therefore it becomes difficult to say in any given case of injury whether the angulation is pathologic or not. It is well known that coccygodynia sometimes occurs without detectable signs of displacement, due to conditions such as arthritis, periostitis, necrosis, etc., and such conditions may affect a coccyx that is naturally angulated, especially after trauma. Dervieux and Bélot (41), in 1926, reporting a case of coccygeal injury, say that the roentgen reading of these cases must be guarded; but if lateral roentgen examination should be made routinely, and the data accumulated, it would undoubtedly result in a greater power of discrimination.

These cases of injury sometimes have an important bearing in industrial work, attention being called to this point in 1910 by Courtois-Suffit and Bourgeois (42). The value of roentgen evidence in compensation disputes or damage procedures is well known. Dr. Podlasky's case (*cit. supra*) was one of industrial accident and it led to a long period of suffering and finally to surgical resection.

In making film records of the coccyx, the presence of a distended bladder or of gas in the rectum usually impairs the detail of the antero-posterior view. Kaisin (43), however, recommended the injection of air into the rectum. The best films are usually obtained with the Potter-Bucky diaphragm, using a restricting cone, a fine focus tube, careful immobilization, especially for the lateral, and the maximum practical distance. In the resulting image by the antero-poste-

rior view, it is usually possible to note the number of coccygeal segments, though the lateral view may sometimes be necessary for a correct count. The antero-posterior view also shows the characteristic shape of the first segment, its transverse processes, and occasionally its cornua, and it registers all lateral deviations. If the curvature is excessive, the coccyx will appear foreshortened, the segments seeming to overlies each other, and only a lateral film will reveal them and their interspaces separately. The lateral view will sometimes register the coccygeal and sacral cornua. Fractures are most likely to occur in the first segment, and be visible in the antero-posterior view, because the line of fracture is most often vertical. In Butler's (44) case the fracture is visible in both views, but the displacement is visible only in the lateral. Luxation may readily escape detection in the frontal projection. In the writer's case it is probable that the coccygeal cornua were broken off, allowing the forward slipping of the first segment.

In the course of correspondence with nearly a hundred roentgenologists on the subject of this article, replies were received from fifty-nine, and films or prints were loaned by eight. Fifteen others stated that they had seen cases, but for various reasons the film record was not available. Four mentioned that roentgen examination is unnecessary because the diagnosis is so easy by physical examination. I wish to take this opportunity of thanking all my colleagues who have answered my appeal, and especially those who sent roentgen records, including Dr. H. B. Podlasky, Dr. G. W. Grier, Dr. P. F. Butler, Dr. W. E. Chamberlain, Dr. P. M. Hickey, Dr. W. A. Evans, Dr. Lawrence Reynolds, Dr. H. A. Spilman, Dr. Samuel Brown, and Dr. T. A. Groover.

CONCLUSIONS

Little attention has been paid in the past to the roentgen examination of the coccyx.

Lateral views are almost necessary in a film study of this area.

The normal coccyx has many variations of length, curvature, fusion, and bony markings, which may cause confusion in interpretation.

Complete and true dislocations, either of one segment or of the entire coccyx, can probably be easily detected on the films. Minor displacements may create doubt.

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³The entries marked by an asterisk (*) cannot be verified, and it is impossible to say from what source Dr. Oakman drew the citations.

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DISCUSSION

DR. H. P. DOUB (Detroit): I believe that Dr. Oakman is to be congratulated for bringing this subject before us, for discussing the literature so thoroughly, and for presenting the collective opinion of the roentgenologists of the country concerning this condition. It is one which is rather infrequently met with, but, nevertheless, is very important because of the many cases referred to us for evidence of possible injury, indicated by pain in this area.

The principal point in this whole discussion is to be able to distinguish between traumatic luxation, fracture, and the anatomical variations which are very common in this bone. This is especially important because these patients who come for examination often have severe symptoms, so that one must make a definite roentgenological diagnosis.

In the study of these cases one finds many variations from the generally accepted normal, but most of them will be found to be due to anatomical variations. In our hospital series a number of cases were operated upon, but, unfortunately, only one of these cases had had X-ray examination previously and the roentgenograms were negative for fracture or dislocation.

From the patient's standpoint, coccygodynia is a very important condition because of the severe pain of which complaint is made. In these cases, however, several conditions should be considered. First, we believe that many of these cases are associated with hysteria and psychosis of some type. In the second place, some of these patients are found to have disease in the sacro-iliac articulation or lumbar spine, with referred pain to the coccyx.

I wish again to congratulate Dr. Oakman upon his presentation of this subject.

DR. JOHN T. FARRELL, JR. (Philadelphia): Dr. Doub has congratulated Dr. Oakman upon his presentation of this subject, but I think the Society is to be congratulated upon receiving such a scholarly discussion of such an important subject.

Pain in the back is very important to the patient, and it is also important to the doctor. This is particularly true in the case of industrial accidents.

We have all known that variations exist in the coccyx, and I think that Dr. Oakman has well pointed out the importance of fundamental anatomical knowledge. It seems to me that the diagnosis of fracture of the coccyx is rarely going to be made without clinical assistance and digital examination.

There is one point which occurs to me, though it seems almost too obvious to mention, and that is the matter of technic. So many of us in dealing with conditions of the spine in clinics are confronted by men who refer patients for just general spinal examination. It is true that it is often impossible to localize the lesion, but in general I think we may say that the smaller the film in relation to the area of suspected involvement, so much more exact will be the information that is ob-

tained. I do not think these studies should ordinarily be made on a 14 by 17 film, a size which would include the entire lumbar column. It is our practice to make them on a 10 by 12, to cover the painful area, and I think the information we obtain is apt to be more definite. This, of course, predicates co-operation on the part of the surgeon, the attending physician, and the receiving ward.

DR. OAKMAN (closing): Dr. Doub, in his discussion, referred to certain indications which are associated with coccygeal pain. It is quite true that the profession at one time, and in particular the gynecologist, was very apt to attribute coccygeal pain to pelvic con-

ditions. I think that a more common-sense view is now prevalent, which attributes almost all cases of coccygeal pain to coccygeal pathology.

The subject of coccygeal pain is of occasional importance in industrial work. This was brought out some seventeen years ago by a French writer, and numerous cases are recorded in the literature, cases wherein injuries to the coccyx have proved to be compensation cases.

One or two writers have insisted that dislocations have never occurred except at the sacro-coccygeal junction. Some of the slides which I have shown indicate that a dislocation may occur at other points.

MEASUREMENT OF LENARD RAYS

By LAURISTON S. TAYLOR, WASHINGTON, D. C.

Abstract.—An investigation is described in which the correct measurement of the electron output—Lenard current—from high voltage cathode-ray or Lenard-ray tubes is attempted.

The evidence presented shows that a Faraday chamber of proper dimensions may be used to measure the Lenard-ray current which at any point is shown to be a linear function of the total tube current. The open-plate method of measuring Lenard currents yields results which are consistently too low, although under the conditions here used they bear a constant relationship to the Faraday chamber measurements. The open-plate measurements are, therefore, also a linear function of the total tube current. The condenser

method of measurement (Thaller) yields measurements above or below those of the Faraday chamber, depending upon the relationship of the atomic numbers of the two plates. Moreover, the current measured by this method is not a linear function of the total tube current and hence does not bear a constant relationship to the Faraday chamber measurements under the conditions used. Measurements of the range of scattered electrons from Lenard tubes operating at about 160 K.V. peak, indicate a maximum of about 15 mm. in air, which is equivalent to an energy of about 60 electron kilovolts. By means of a variable Faraday chamber described, it is possible to obtain a measure of the velocity distribution of the scattered electrons.

I. INTRODUCTION

(1) *Early Use of Lenard Tubes*

IN 1925 Coolidge described a high voltage hot cathode tube of the Lenard type by means of which high speed electrons passed through a thin (.0015 in.) metal window from the tube into the open air.¹ His principal improvement over the original Lenard tube lay in the very large increase in the number and speed of the electrons transmitted through the foil window. He has constructed a cascade tube operating at 900 K.V. and 2 ma. on an induction coil. More recently Slack² has developed a similar tube having a very thin (1 micron) concave glass window and operating up to at least 350 K.V. in a single stage.

Since the introduction of the Coolidge tube, a wide variety of investigations have been undertaken having in view its applications in the fields of physical, chemical, and

biological research. Coolidge and Moore³ made the first qualitative studies of various effects of the electrons upon substances in air as well as the effects upon animal tissue and bacteria. McLennan⁴ and his co-workers have since carried out very extensive studies of their effect upon chemical reactions. In the biological field, the most comprehensive studies have been carried out by Schaeffer and Witte,⁵ and Baensch and Finsterbusch,⁶ of whom the former made the first attempt to apply physical measurements of Lenard-ray currents to biological reaction.

The greater part, however, of all this work has been done with very little accurate knowledge of the magnitude of Lenard-ray quantities involved. The object of the present communication is to describe a study

¹W. D. Coolidge and C. N. Moore, *Jour. Frank. Inst.*, 1926, CCII, 722.

²J. C. McLennan, Perrin, and Ireton, *Proc. Roy. Soc.*, 1929, CXXV, 246.

³W. Schaeffer and E. Witte, *Strahlentherapie*, 1929, XXXI, 415.

⁴W. Baensch and R. Finsterbusch, *Strahlentherapie*, 1929, XXXIII, 399.

¹W. D. Coolidge, *Jour. Frank. Inst.*, 1926, CCII, 693.

²C. M. Slack, *Jour. Opt. Soc. Am.*, 1929, XVIII, 123.

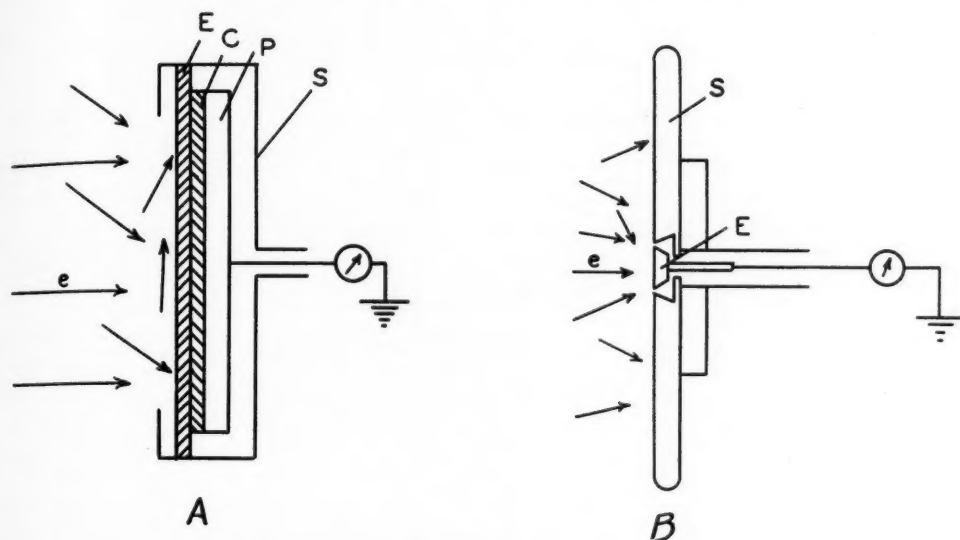


Fig. 1. Lenard-ray collectors: (a) Schematic diagram of Lenard-Thaller condenser collector for measuring Lenard rays; (b) Cross-section of Taylor open plate collector.

of several methods for measuring the current of the high speed electrons in air under conditions suitable for general experimental application.

To avoid possible confusion in speaking of the various currents it is well to differentiate between them. By the *total current* is meant the electron stream leaving the filament, irrespective of its ultimate destination. There is also a current composed of high speed electrons in air, called the *Lenard current*. Its current density—which is directly proportional to the number density and velocity of the electrons—varies with distance and direction from the window. Most of the measurements described below are in terms of current density.

Experiment shows that it is insufficient and often misleading to measure the electron current at some point outside the tube in terms of the current through the tube and the voltage applied to the tube. While this may be satisfactory for reproducing conditions with a given set-up, many complicating factors render it useless from the view-

point of reproduction under other slightly different conditions.⁷

(2) Methods of Measuring Lenard-ray Currents

Three methods of measuring Lenard-ray currents were announced almost simultaneously. Thaller⁸ used a modification of a method described by Lenard⁹ and shown diagrammatically in Figure 1-A. The high speed electrons, e , pass through a layer of noble metal, E , about 0.001 mm. thick, deposited on a somewhat thicker layer of copper oxide, C , or other insulating material, to the backing plate, P , and thence through a galvanometer to ground. The current through the galvanometer is then taken as the Lenard current.

The writer¹⁰ has described some prelimi-

⁷It might be mentioned that, at the outset of this work, a number of erroneous results were obtained due to what later proved to be the improper measurement of the tube current alone.

⁸R. Thaller, *Strahlentherapie*, 1929, XXXIII, 263.

⁹P. Lenard, *Ann. Phys. u. Chem.*, 1898, LXIV, 288.

¹⁰L. S. Taylor, *RADIOLOGY*, April, 1929, XII, 294-296.

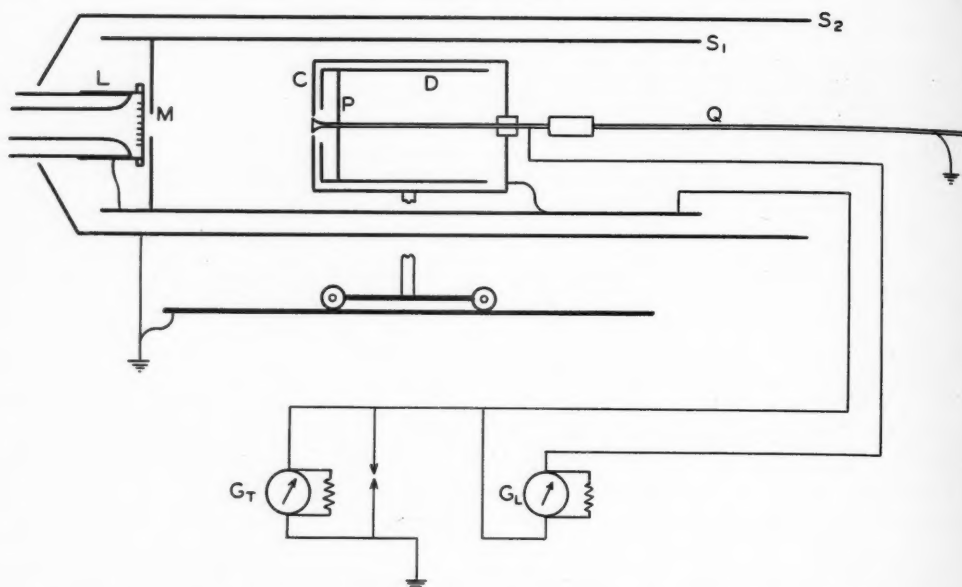


Fig. 2. Diagram of experimental set-up for comparing the condenser, open plate, and Faraday chamber methods of Lenard-ray measurement.

nary measurements made by the apparatus shown in Figure 1-B wherein the electrons were allowed to impinge upon a small aluminum plate, *E*, surrounded by an earthed guard plate, *S*, so designed as to avoid error due to electrons entering the space between *E* and *S*.¹¹ The current from plate to ground as measured by the galvanometer was taken as the Lenard current.

Schaeffer and Witte¹¹ expressed their intensities in terms of the air ionization produced, having made the necessary corrections for the additional ionization produced by the associated X-rays. This method aims to obtain a measure of the energy, whereas the preceding method deals only with the current; therefore, the measurements cannot be directly compared.

The ionization currents produced by Lenard beams are relatively large. For example, consider an electron beam having a current density of only 8×10^{-8} amp./cm.² (as in some of the work described below)

and assume complete loss of velocity of all the electrons—which have an average speed¹² of 125 electron kilovolts. Using Eisl's¹² value of 32.2 volts loss of velocity to yield one pair of ions, it is found that 1.9×10^{15} ion pairs are formed per second by this stream, which should give a saturation current of 3×10^{-4} amperes per square centimeter—4,000 times the initial electron current.

In spite of the advantage of yielding conveniently large currents, other experimental difficulties, discussed below, render the ionization method of Lenard-ray measurement less satisfactory, however, than the electron current method. In this study we have used a Faraday chamber method as a basis of comparing the first two methods above.

The Lenard current is measured in terms of the unit previously proposed by the author,¹³ as that beam having an *electron current density* of one E.S.U. per square centimeter normal to the direction of the

¹¹W. Schaeffer and E. Witte, *Strahlentherapie*, 1929, XXXI, 415.

¹²A. Eisl, *Ann. der Physik*, 1929, III, 277.

¹³See Footnote 10.

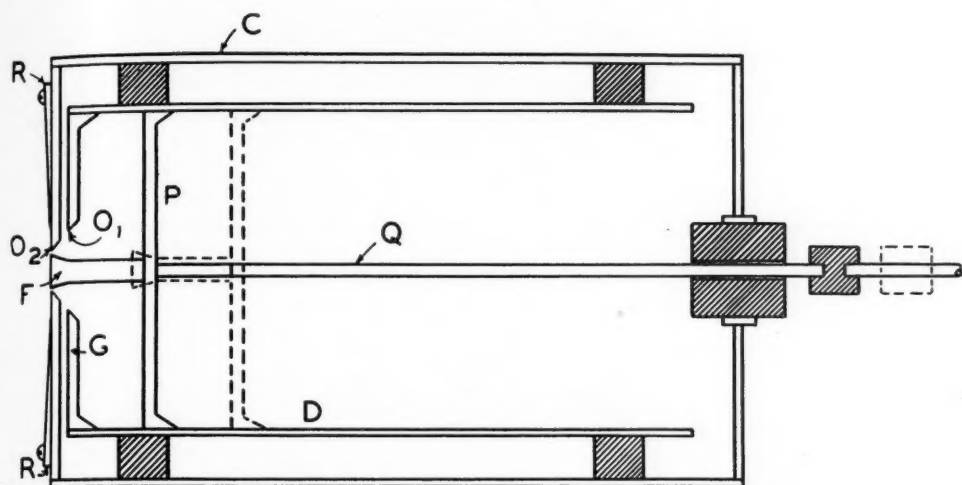


Fig. 3. Cross-section of adjustable Faraday chamber. Broken lines indicate position of plunger when drawn back. Cross-hatched section indicates hard rubber.

beam. This was called the "lenard" and was designated by the letter L. It is obvious that, due to scattering of the electrons in air, the current density will be essentially uniform over only a very small area. Hence it was thought desirable to restrict the measurements to the current over an area only 1 cm. in diameter rather than some 10 cm., as in Thaller's system. The intensity of the beam striking the center of such a large collector as Thaller's will be very different from that striking the edges, so that in effect he measures an average intensity. As mentioned, this type of measurement is not directly comparable with Schaeffer and Witte's.

II. EXPERIMENTAL INVESTIGATION

(1) Tubes and Generating Equipment

Two types of hot cathode Lenard tubes were used in this investigation. The first was the Coolidge type, having a large flat metal foil window supported on a honeycomb grid. The foil was of nickel about 0.03 mm. thick. The tube operated continuously on a metal four-stage mercury diffusion pump. The second tube was of the

Slack type, having a drawn-in glass window about 0.002 mm. thick, with an effective opening of about 3 cm. diameter. This tube was sealed off the pumps.

Both tubes were designed to operate at about 350 K.V. peak and were tested by us up to 325 K.V. (the limit of our system). The window of each was cooled by radiation and conduction alone; and, to permit steady continuous operation over periods of several hours, comparatively low tube currents were used—of the order of 20 micro-amperes for the Slack tube and 100 micro-amperes for the Coolidge tube. When comparing the observations made with small currents against those made using larger currents of shorter duration, no essential differences were observed except in the magnitude of the Lenard currents measured.

Since the range of the electrons in the thin windows varies as the square of their voltage, according to the Thomson-Whiddington-Bohr law, it is obvious that for a given tube current the minimum heating of the window would occur when applying strictly constant voltage to the tube. It has been observed that, for such tubes as here used, most electrons having a velocity under

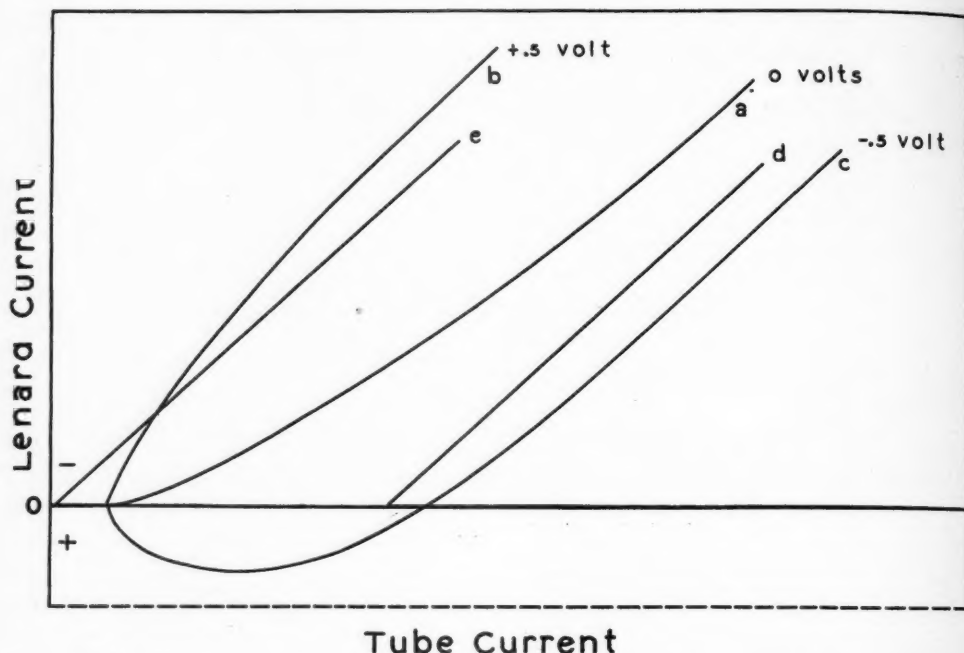


Fig. 4. Curves showing effect on Lenard current readings caused by poor electrostatic shielding and by potential differences between collector and guard ring. Scales of same order as in later figures.

75 electron kilovolts are completely absorbed in the window, and hence are effective only in producing heat and a few X-rays. Thus when applying other than constant voltage to the tube only that portion of the wave above 75 K.V. is effective in producing the results sought.

Not having available a suitable constant voltage source for this work, a disc mechanical rectifier was used in which rectification occurred over approximately 15–20 degrees. For convenience of measurement, the anode and window of the tube were at ground potential and a maximum of about 160 kilovolts was applied to the cathode.

Tubes, generating equipment, and measuring apparatus were placed for safety in a large room lined with $\frac{1}{4}$ -inch lead, and all controls and indicating instruments were brought outside and so arranged as to permit the variation and measurement of all quantities without the necessity for entering the room. This had the one undesirable

feature of requiring very careful electrostatic shielding of all parts of the apparatus to prevent the sensitive galvanometers from picking up electrical disturbances from the mechanical rectifier and high tension leads.

(2) Apparatus Used for Comparing Lenard-ray Measurements

In order to facilitate the comparison between the three systems outlined above, namely, Thaller's condenser system, Taylor's open plate system, and the Faraday chamber, a single Lenard-ray collector was designed in such a manner as to readily measure the electrons according to any one of the methods.

The collector, C, in Figure 2, was mounted on a grounded track so as to be movable through a distance of about 25 cm. from the tube window, L, in any direction from zero to an angle of 150° with the axis of the tube. The outer case of the collector,

the copper gauze shield, S_1 , and the tube anode were connected together through a galvanometer, G_T , to ground. This system was surrounded by a second copper gauze shield, S_2 , which was grounded. Both S_1

large adjustable Faraday chamber. The plunger, P , supports a collector, F , of which the outer end, having a diameter of 9.8 mm., passes through the opening, O_2 , in the outer case, C , with a clearance of 0.1 millimeter.

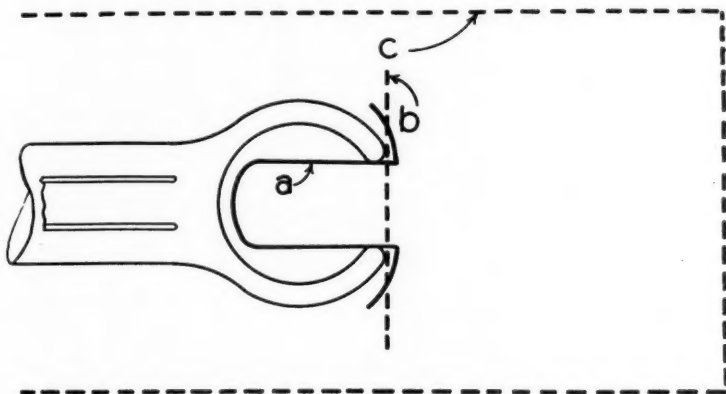


Fig. 5. Arrangement of collectors a , b , c , for measuring total Lenard current when the air volume in front of Slack tube is varied.

and S_2 were so slotted as to permit the ready movement of the collector along the track.

Figure 3 shows a detailed diagram of the collector used as a basis of comparison. The inner cylinder, D , carefully insulated from the case, C , contained a plunger, P , which could be moved by means of the rod, Q , from outside the lead room. Both inner cylinder and plunger were connected through the galvanometer, G_L , to the galvanometer circuit, G_T , as indicated. Galvanometers, all lead wires, shunts, etc., were completely surrounded by earthed shielding. Thus the galvanometer, G_T , indicates the total electron current of the tube, made up in part of the small electron current to the Faraday chamber as measured by G_L . A current measuring system placed thus in the grounded circuit is preferable when dealing with currents as small as those involved, since it does not measure any of the corona losses in the high tension circuit.

The complete collector is essentially a

The Faraday cylinder, D , has its front end, C , adjustable in position along the axis so as to vary the spacing between C and G . The opening, O_1 , in the Faraday chamber, and O_2 in the case are tapered in such a manner that all the electrons (except those at a glancing angle) incident on the plane of O_2 will pass into the chamber when the plunger is drawn back. On the front of the outer case is a thin tapered ring by means of which thin metal covers may be securely clamped over the opening, O_2 .

This system may be used for any of the three methods described above. By placing the collector, F , flush with the outer face of the case we have the open plate system. By moving the plunger back into the cylinder, D , a Faraday chamber is obtained. To obtain Thaller's condenser system, a thin metal foil and insulator may be clamped under the ring, R , and then F moved up to just bear on the insulator under the foil. Moreover, by moving the piston back while the opening,

O_2 , is covered, we can effectively measure the transmission of the foil and insulator by the Faraday chamber method.

Care must be taken to properly identify any currents measured, since the total tube

of M -striking the outer conducting wall of the tube; (4) the electrons striking the shield, S_1 , and the Faraday case front, C ; (5) the electrons entering the Faraday cylinder, D . If the shields, S_1 and S_2 , are re-

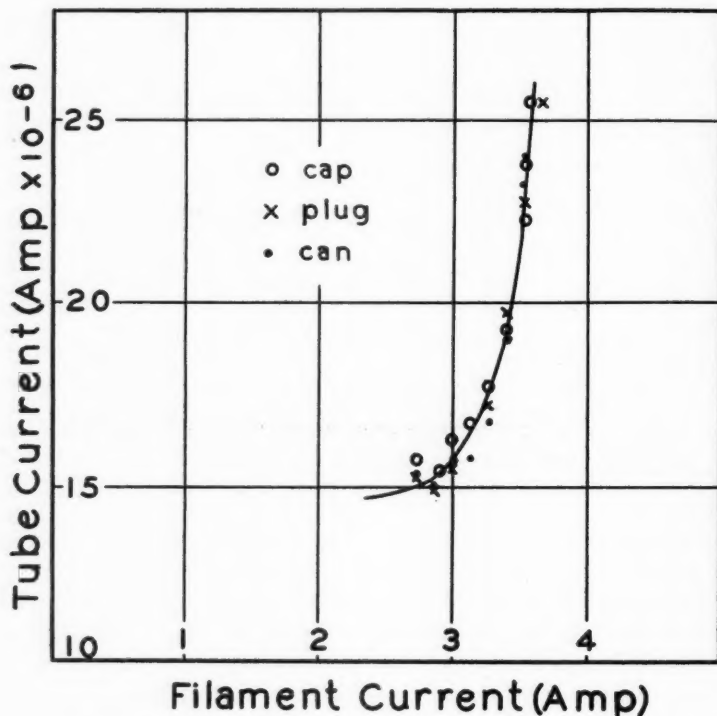


Fig. 6. Total Lenard current as a function of filament current.

output may be considered as made up of a number of separate parts. A correct measure of the tube current is not obtained by measuring simply the current between anode and ground, since this does not measure the electrons that pass through the window. The total tube current consists of the following parts: (1) the current to the anode (including the window), of which a large part is due to electrons scattered from the primary cathode beam within the focusing tube; (2) the current to the diaphragm, M , (Fig. 2); (3) the electrons scattered back

moved, the Part 4 will be reduced while the Part 3 will be increased. Moreover, the amount of these changes will depend to a considerable extent upon the relative positions of the diaphragm, M , and the Faraday case, C .

Figure 4 shows a series of curves of the Lenard current, measured with the open plate collector, as it varies with total tube current for a fixed voltage on the tube. These are given to indicate, without going into detail, the necessity for careful shielding and the elimination of stray potentials

in the system. Curves *a*, *b*, and *c* were taken with both shields, S_1 and S_2 (Fig. 2), removed; *a* with the center electrode at exactly the same potential as the case; *b* and *c* with the center electrode maintained at

chamber. Since the entire space (outside and inside the chamber) is highly ionized, it must be assured that the net flow of current to the collector is simply the primary electron current—that other positive and nega-

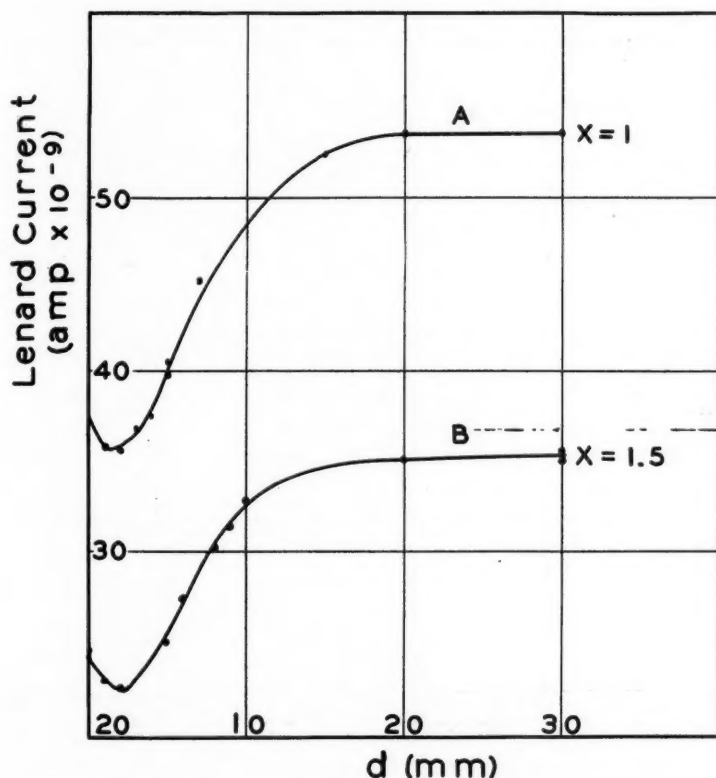


Fig. 7. Lenard current as a function of the distance d which the plunger is withdrawn, for two distances x between collector face and tube window.

about 0.5 volt above and below the case potential, respectively. The slight displacement from the origin was due to stray field disturbance. Curve *d*, taken with only S_2 removed, is linear but passes far from the origin due to an excessively large field disturbance picked up by S_1 . Curve *e* for a completely shielded system is linear and passes through the origin.

(3) Measurement of Total Electron Current

The first point investigated was the correctness of the indications of the Faraday

tive ions either recombine or reach the collector in equal numbers.

One way of testing this is by measuring the apparent total tube output current, say, as a function of the filament current, while varying over wide limits the air volume in front of the tube. This was accomplished in the case of the Slack tube by inserting first a closed lead cylinder, *a* (Fig. 5), into the window, so that there was practically no volume of air to be ionized; second, covering the opening with a flat plate, *b*, so that only the space inside the mouth of the win-

dow was ionized, and third, enclosing a large volume of air in front of the tube with a can, *c*. With the Coolidge tube a can only was used. A plot of the total tube current

the total Lenard current. That the current, measured by the Faraday chamber, is a definite fraction of the total is supported by mutually consistent results discussed below.

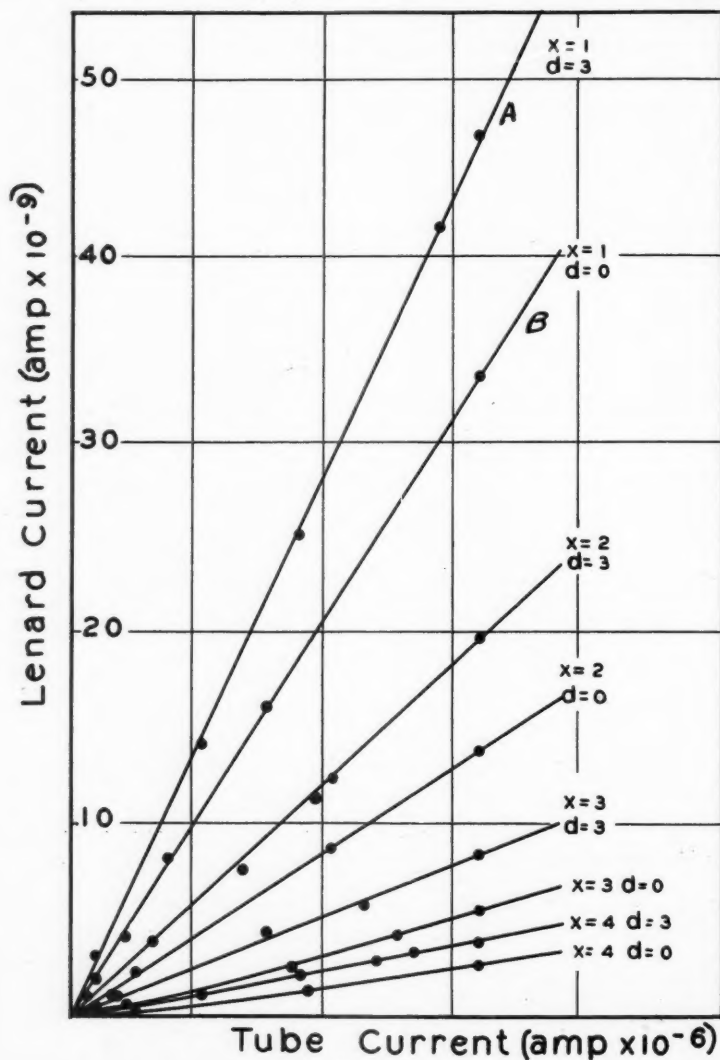


Fig. 8. Lenard current as a function of tube current for different values of *x* and *d*. The ratio of the A curves to the corresponding B curves is the same for all values of *x*. Values of *x* and *d* are indicated in centimeters.

as a function of the filament current for these three sets of conditions (Fig. 6)—giving the same results for all three cases—proves that the current measured by G_T was

(4) Comparison of Open Plate and Faraday Chamber Methods

The next point investigated was the effect

of moving the collector, F , back from the position where it was flush with the outer case. Two curves, A and B (Fig. 7), show the change in current to the Faraday cham-

ber identified as follows: (a) when the collector is flush with the outer case, as the plate or collector plate current; (b) when the current no longer changes with d , as the

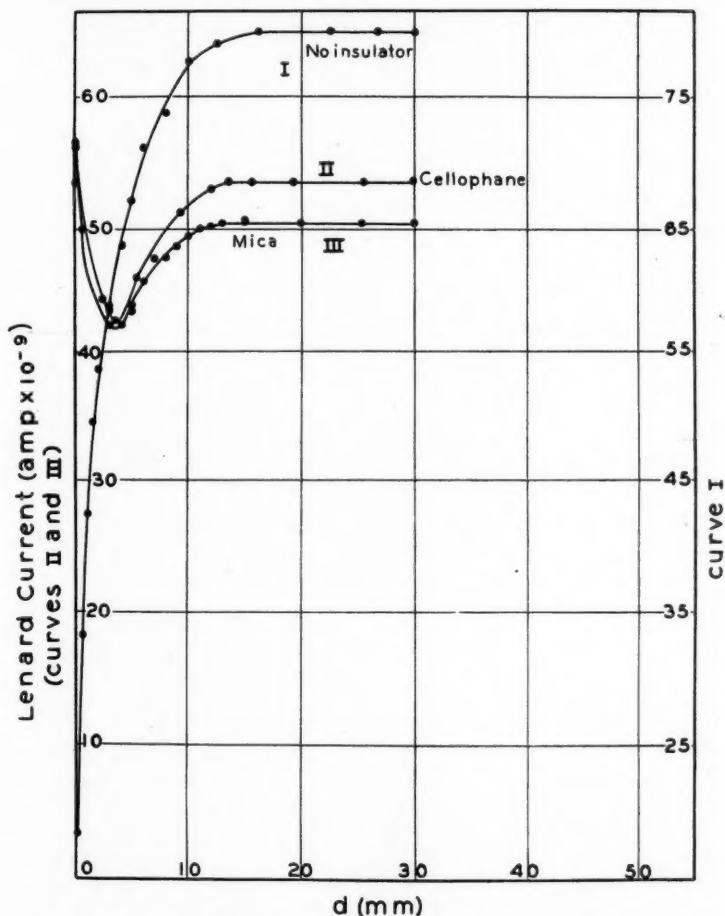


Fig. 9. Lenard current as a function of the distance d for different dielectrics between the aluminum collector window and plunger.

ber as a function of the distance d between F and the front face of the outer case, C (Fig. 3). It will be noticed that the current for values of d greater than about 1.5 cm. is about 33 per cent greater than for conditions where F and C are flush.

To avoid confusion in speaking of the currents measured by G_L for different positions of the collector, F , the currents will be

complete or complete Faraday current; (c) when the current is intermediate between the two cases above, as the intermediate current. Two cases where the distance, x , between C and the Lenard tube window is 1.0 and 1.5 cm., are shown by Curves A and B , respectively. Other conditions remaining the same, the ratio between the plate and complete currents was approximately the

same for all values of x and all tube potentials used. Since the velocity distribution of the electrons in the beam subtended by the opening, O_2 , will vary with both tube potential and the distance, x , hence, the ion-

reached when d reaches 20 mm., for the particular arrangement of the inner cylinder. Both of these points may be shifted slightly by changing the size of O_1 or the distance between O_1 and O_2 . The minimum

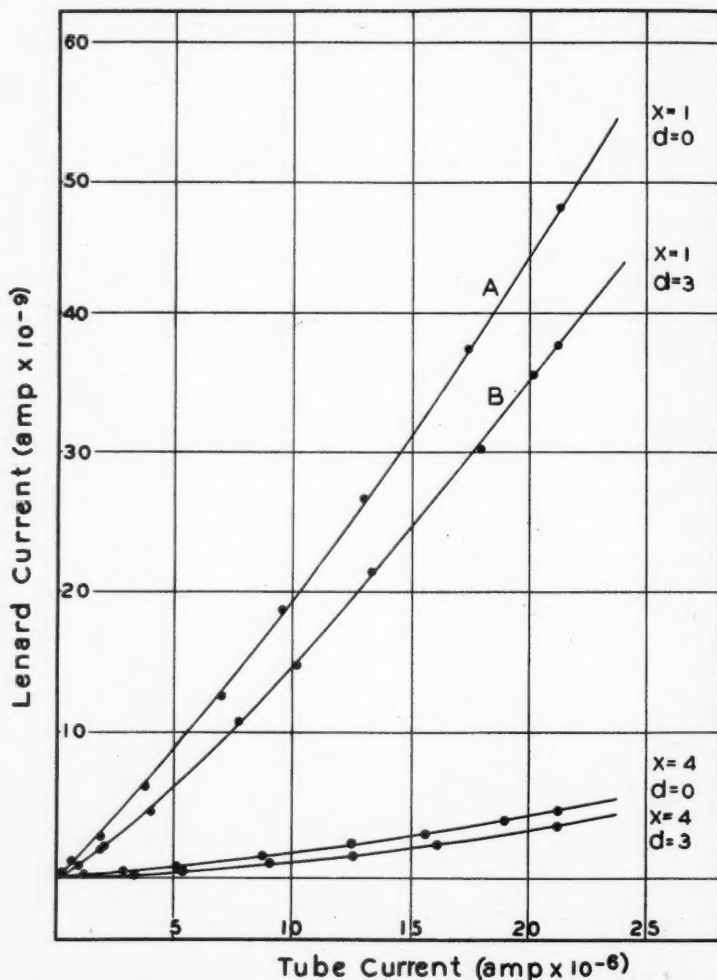


Fig. 10. Lenard current as a function of the tube current for the condenser collector. The ratio between Curves A and B is the same only for the same values of the tube current; x and d are indicated in centimeters.

ization intensity distribution will vary with both, it may then be safely assumed that the form of the curves in Figure 7 is not due to positive or negative ions.

The minimum always appears at d about 2 to 3 mm. and the saturation current is

may be explained as due to the fact that as the collector, F , recedes, the opening, O_2 , prevents electrons from striking it at the more grazing angles. The subsequent gradual approach to a complete Faraday current at $d = 20$ mm. is due to the gradual reduction

in scattering of electrons from the face of F to the edges of the opening, O_2 , or even entirely out through O_2 .

Figure 8 gives representative curves showing the current as a function of the

and, further, since it is found that the ratio of the two currents at any one value of d and any two values of x is the same for all tube currents, it is to be concluded that the ionization density in front of the collector,

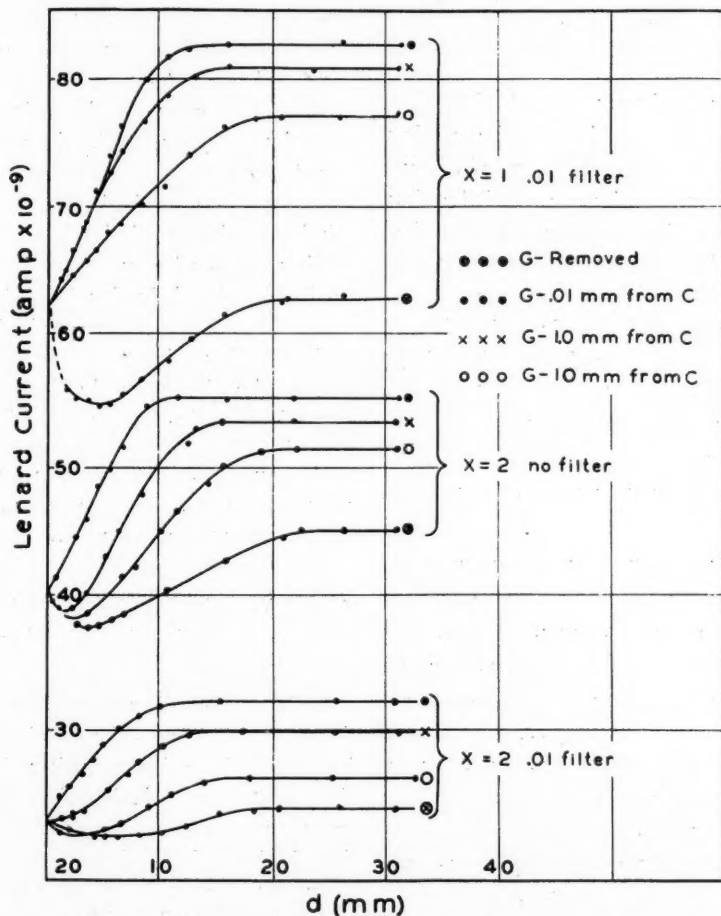


Fig. 11. Lenard current as a function of d for various filters and for various positions of the diaphragm G (Fig. 3).

Errata: In legend for "G-.01 mm. from C" (above) read "G-.027 mm. from C."

total tube current for four different distances, x (10, 20, 30, 40 mm.), from the tube window and two different distances, d (0, 30 mm.), of the collector plate, F , for each value of x . Since from these it is seen that the ratio of the two currents at any one value of x is the same for all tube currents;

which must change greatly over this range of conditions, does not affect the measured magnitudes. Curve A , taken for $d = 30$ mm., is seen to be about 33 per cent greater than Curve B , taken with $d = 0$, which is in good agreement with the curves shown in Figure 7.

We may conclude from these results that the open plate measurement of any Lenard current bears a constant ratio to the Faraday chamber measurement.

(5) *Comparison of Condenser and Faraday Chamber Methods*

To test the condenser method of Lenard-current measurement (Thaller), the opening, O_2 , was covered with a 0.01 mm. aluminum foil clamped in place by means of the ring, R (Fig. 3). The collector, F , was then moved back just sufficiently to prevent contact with the foil—about 0.02 mm.—forming a condenser with an air dielectric and having as plates the aluminum foil and the collector, F . As seen by Curve I in Figure 9 the Lenard current I_L for $d = 0.02$ mm. is very small but increases rapidly to a complete value several fold larger at $d = 20$ millimeters.

To reproduce Thaller's method more closely, the aluminum foil was backed with a mica sheet 0.015 mm. thick to serve as a solid dielectric in place of the air and the collector, F , then placed in close contact with the mica. Curve III in Figure 9 shows the Lenard current I_L as a function of d , whence it is seen that the complete value of I_L for this particular case is some 12 per cent lower than the plate ($d=0$). It is also noticed that the intermediate current I_L passes through a minimum as in the case of the open Faraday chamber. Curve II taken with a 0.027 mm. layer of cellophane in place of the mica shows a similar curve—reaching a minimum and complete value for exactly the same values of d . It should be pointed out that the equal values of I at the minimum is accidental and in general will differ for different thicknesses of the dielectric. Also the ratio of plate to com-

plete value of I_L will vary with the dielectric thickness used.¹⁴

Contrary to the case of the open plate, the plate and complete currents are not linear functions of the tube current. Plotting, as in Figure 8, I_L against the total tube current (as the filament current is varied), the curves shown in Figure 10 are obtained; Curve A with $d = 0$ and Curve B with $d = 30$ millimeters. The ratio is found to vary but slightly as I_L increases. Compared, however, with the Faraday chamber or open plate method, the varying ratio eliminates the possibility of reliably determining Lenard currents by Thaller's method. This behavior is to be expected since, in the condenser method, electrons will pass through the dielectric at various angles, the absorption in the material will depend upon the degree to which the electrons have a velocity normal to the collector. This will vary with the ionization density in front of the tube, which, in turn, will vary with the tube emission.

(6) *Effect of Changing the Dimensions of the Faraday Chamber*

Before proceeding to a discussion of the form of the curves found above, it is of interest to investigate further the effect of the dimensions of the Faraday chamber upon the current measurements. Having found the effect of varying d , that of changing the position of the inner diaphragm, G (Fig. 3), with respect to the front cover, C , using two different qualities of Lenard radiation and two distances x between Lenard tube and Faraday chamber, was sought. The radiation quality was changed by placing a 0.01 mm. aluminum filter in the beam at distances of 3 and 13

¹⁴It might be mentioned that whereas a single sheet of mica has lasted throughout these experiments, cellophane turns yellow and becomes very fragile with a few hours' use at the current densities here employed. As a result a new sample was used for each set of observations, with the result that slight discrepancies exist between the curves.

mm., respectively, from O_2 , the corresponding positions of the chamber being $x = 10$ mm. and $x = 20$ mm., respectively. In both cases the current, I_L , to the Faraday cylinder was measured as a function of the

place. This is to be expected since a large number of the electrons scattered from the chamber will strike the outer grounded cover, C , and not become a part of the collector current except for the few rescattered

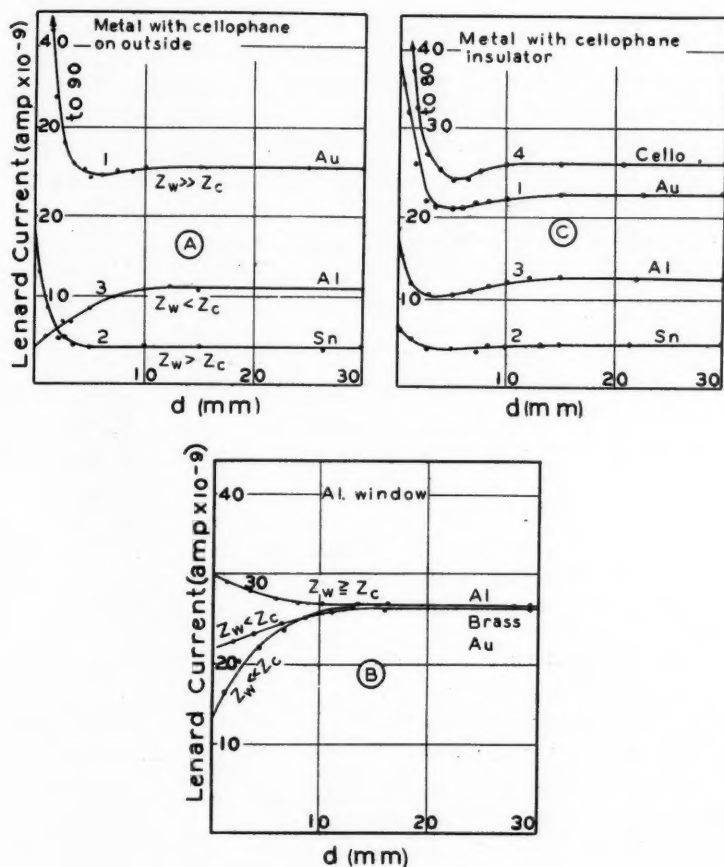


Fig. 12.

displacement d of the collector. The spacing between the plates G and C (Fig. 3) was made 10 mm., 1 mm., 0.027 mm. (held apart by a cellophane spacer near the periphery), and G removed entirely.

The resulting curves are given in Figure 11 and need little explanation. In all cases, the curves for G removed have a very much lower complete value than where it is in

to the wall, D , of the chamber. As the plate, G , is moved closer to C the complete currents increase in all cases, the maximum being for the 0.027 mm. spacing. With a chamber so constructed that all electrons incident over the plane of O_2 could enter the collector, the complete value would probably be slightly greater. Inspection also shows that the complete Faraday current point is reached

at successively smaller values of d as the spacing between C and G is decreased. This may be attributed to the fact that by decreasing the plate spacing, electrons are prevented from reaching the grounded case (including the beveled edges of O_2) and being lost.

III. EFFECT OF ELECTRON SCATTERING

The definite complete value of I_L , occurring always at the same value of d (for a given peak voltage and fixed dimensions of the chamber), would indicate that the electrons scattered from the face of F have a maximum velocity determinable from their range in air. Since the curves all reach the saturation at about $d = 15$ mm. we may conclude that this is the maximum range of the scattered electrons. (There will undoubtedly be scattered electrons having very nearly their initial velocity corresponding to about 150 kilovolts, but the quantity appears to be immeasurably small compared with the currents here used.) On the basis of Coolidge's data¹⁵ on the range of electrons in air, the maximum energy of the scattered electrons would be about 60 electron kilovolts.

Since the initial velocity of the greater part of the scattered electrons will be low, we find the greatest rate of change of I_L with d for small values of d . Thus, from the shape of the curve below the complete Faraday current point we might expect to obtain some idea of the velocity distribution in air of the backward scattered electrons, from which, in turn, could be determined the velocity distribution of the electrons in the initial beam, thus defining the quality of the beam.

The velocity distribution of the scattered electrons will, of course, depend upon the material of the collector, and the quantities actually measured will in addition depend upon the surrounding walls where rescatter-

ing occurs. Thus the quantity measured is the net result of a differential scattering. This is indicated by some of the curves in Figure 12, where I_L is plotted as a function of d . Group A was obtained using gold (atomic number $Z = 79$), tin ($Z = 50$), and aluminum ($Z = 13$) as thin covers over the opening, O_2 . These covers had different thicknesses and were themselves covered on the *outer* side by 0.027 mm. cellophane so that the absolute values of I_L are not comparable. The collector, F , was brass (Z about 30) as used heretofore. Electrons scattered from F are in part rescattered from and in part absorbed by the window.

Curve 1 for a gold window gives a very high plate current. Curve 2 for tin is similar in this respect though relatively smaller than for gold. Curve 3 for aluminum shows, on the other hand, a plate current lower than the complete current, and we find that in general when the atomic number, Z_w , of the window is greater than that, Z_c , of the collector the plate current is larger than the complete, and *vice versa*. This indicates that the net scattering reverses with the relative position of the scatterers in the atomic number scale.

To check this as it affects the type of measurements here involved, the curves in Group B were obtained, which seem to support this view. Here the window was of aluminum in all cases, while the face of the collector, F , was covered successively with aluminum, brass, and gold. The relative plate and complete values of I_L occur in an order which is the reverse of that shown by Curves A. The slight increase in the case of two aluminum scatterers may be attributed to a small amount of brass exposed by the beveled edges under the aluminum window.

With a cover of cellophane or mica over O_2 , the complete value of the current is less than the plate and hence does not obey the relationship to atomic numbers found for

¹⁵See Footnote 1.

the metal foils. Curve 4 in Group C, showing the variation of I_L with d , for a cellophane window over the Faraday chamber, is seen to give a higher plate than complete value for the current I_L .

Curves 1, 2, 3 show the effect of a cellophane insulator used behind a metal foil to form a window to the chamber. In all cases the plate currents are higher than the complete. In comparing these curves with those where the cellophane was on the outer side of the window (Fig. 12-A) it is seen that the complete currents are approximately the same. This again shows that Faraday chamber measurements bear a constant relationship to the current in the total beam irrespective of the nature of the material

through which the electrons pass in entering the chamber. The general form of the curves for the two conditions is the same only when the atomic number of the window is greater than that of the brass collector. In the case of an aluminum window backed with cellophane, however, the form of the curve for cellophane alone seems to predominate, the Curve C-3 appearing to be a combination of A-3 and C-4.

The author is indebted to Mr. C. F. Stoneburner, of this laboratory, who ably carried out all of the construction and measurements involved in this investigation. He is likewise indebted to Dr. W. D. Coolidge and to Dr. C. M. Slack, by whom the several cathode-ray tubes were loaned.

A SIMPLE METHOD FOR CALCULATING DOSES WITH MULTIPLE POINTS OF GAMMA RADIATION

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THE measurements and calculations in this paper were made in an endeavor to arrive at a simple method of determining a suitable distribution, dosage, and intensity at depth for radium or radon tubes when used with Columbia paste packs. The work of Quimby¹ along these lines suggested this work.

Two methods were used, photographic and ionization measurements.

(1) *Photographic*.—Films were exposed to determine the arrangement of tubes at various distances which would radiate uniformly a given area. From the results of these exposures the following conclusions were drawn:

(a) Most conditions will be satisfied by the three arrangements of tubes shown in Figure 1.

(b) At 1 cm. distance the maximum spacing between parallel tubes should be 1 cm., center to center. When in tandem, the tubes should touch, end to end.

(c) At 2 cm. distance the maximum spacing between parallel tubes should be 2 cm., center to center, and tandem tubes should touch.

(d) At greater distances than 2 cm., greater spacing between parallel tubes would not be satisfactory because at these greater distances the intensity at the skin would be reduced to such an extent as to make it advisable to use more radium, in order to shorten the treatment.

2. *Ionization Measurements*.—The experimental arrangement of electroscope, ion-

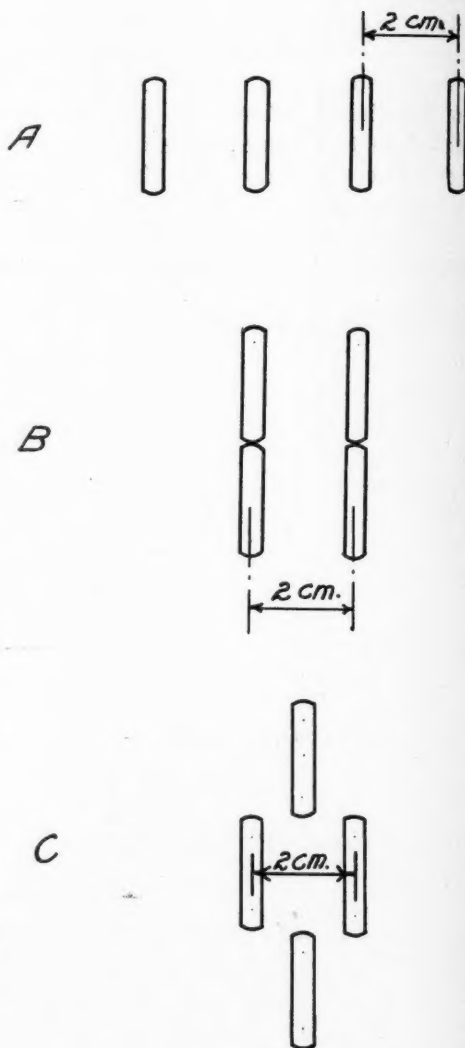


Fig. 1. Three arrangements of tubes.

ization chamber, and radium is shown in the accompanying diagram. (Fig. 2.)

¹Quimby, Edith H.: Effect of Size of Radium Applicators on Skin Doses. Am. Jour. Roentgenol., October, 1922, IX, 671-683.

The electroscope was in a separate room, insulated by one-eighth inch lead, and the radium to be measured was in the adjoining room. The electroscope was so placed as to be in the direct shadow of a lead block 8 by

tain the desired distance. The radium tube was 21.5 mm. long, 4 mm. outside diameter, having a wall thickness of 1 mm. platinum. The results of these measurements are shown as an isodose curve in Figure 3. The

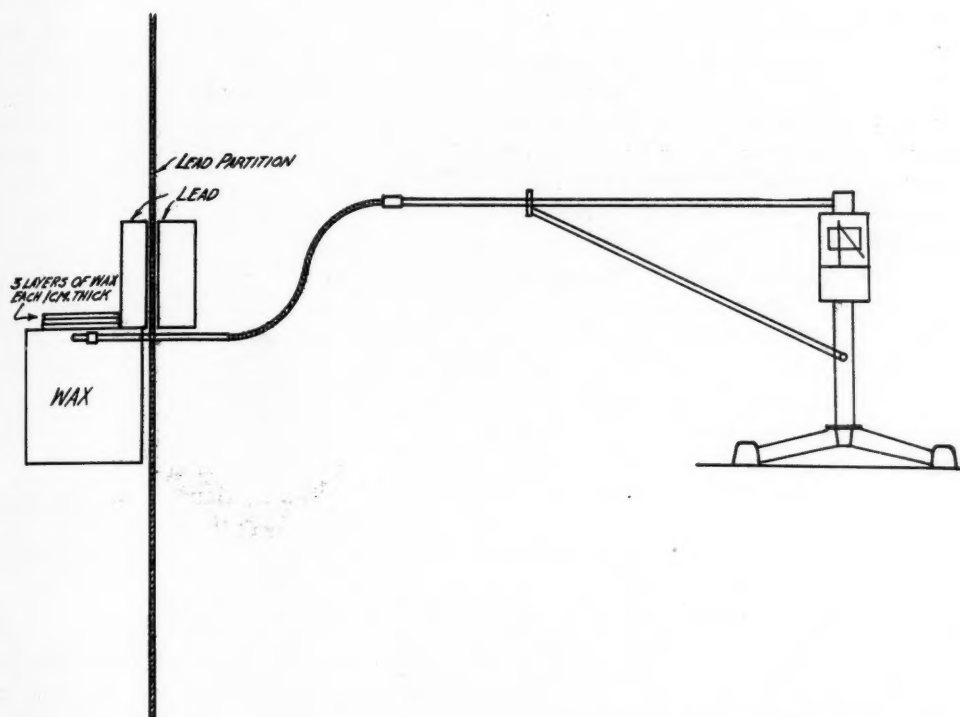


Fig. 2. Diagram showing the experimental arrangement of electroscope, ionization chamber, and radium.

10 by 4 inches thick. With this arrangement the leakage was so small that the discharge readings were not affected. The ionization chamber was made of bakelite impregnated with graphite, and had an outside diameter of 9 mm. and a wall thickness of 0.25 millimeter.

The intensity around a single radium tube was measured, at distances 1, 2, 3, 4, 5, 6, 8, 10, and 12 cm. from the center of the ionization chamber to the center of the radium tube. Wax spacers were used to ob-

perfect semicircles are probably not maintained near the surface, due to scattering. These same values are shown in another form in Figure 4. This curve, drawn to a much larger scale than shown here, was used to calculate the intensities from various tubes at various distances, in the following manner.

Four points, representing the midpoint of four parallel tubes, were placed 2 cm. apart and 2 cm. away from a line representing the skin. A point *R* (see Fig. 5) on this line

was chosen as being the center of the field. The distances from each tube to this point were carefully measured and the intensities corresponding to these distances were then read on Figure 4. Thus the intensity at point *R* was the sum of the intensities contributed by the four tubes, or 70.4 per cent

Tube	Distance from Skin	Intensity at <i>P</i>
1	d 2.82 cm.	16.0 per cent
2	c 2.0 cm.	30.0 per cent
3	d' 2.82 cm.	16.0 per cent
4	e 3.18 cm.	7.0 per cent
		<hr/> 69.0 per cent

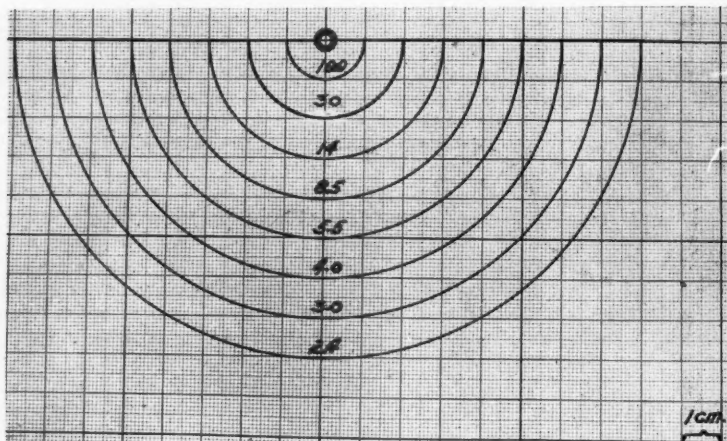


Fig. 3. Isodose curve. See text.

of the intensity applied 2 cm. above the skin. The actual measurements and values are given below.

Tube	Distance from Skin	Intensity at <i>R</i>
1	b 3.63 cm.	10.2 per cent
2	a 2.24 cm.	25.0 per cent
3	a' 2.24 cm.	25.0 per cent
4	b' 3.63 cm.	10.2 per cent
		<hr/> 70.4 per cent

There was a possibility that a point directly under one of the tubes would have a greater intensity than the point chosen in the center of the field, therefore point *P* was selected and the intensity determined as before.

The close agreement between 70.4 per cent in the center of the field and 69.0 per cent 1 cm. on either side proves that there is no so-called "hot spot," and bears out the photographic findings that radium spaced 2 cm. apart at 2 cm. distance from the skin radiates uniformly.

The same procedure was followed in determining the intensity at a point *S* 1 cm. below the skin.

Tube	Distance from Skin	Intensity at <i>S</i>
1	d' 3.18 cm.	13.0 per cent
2	c' 4.26 cm.	7.6 per cent
3	c 4.26 cm.	7.6 per cent
4	d 3.17 cm.	13.0 per cent
		<hr/> 41.2 per cent

The ratio 70.4 : 41.2 : : 100 : X
X = 58.5 per cent

Therefore, if 100 per cent is given to the surface instead of 70.4 per cent, then at 1 cm. below the surface there will be an intensity of 58.5 per cent.

Following this method, intensities were calculated for 1-8 parallel tubes separated 1 cm., and for 1-14 parallel tubes separated 2 cm., at radium skin distances of from 2 to 6 centimeters. Plotting these intensity figures, smooth curves were drawn for each combination of tubes at the various distances, to eliminate some slight irregularities. The values obtained from these curves were then converted into factors, using the intensity at 1 cm. with one tube as unity. By means of these factors, the intensity for any combination could be converted to 100 per cent at any given distance. These dosage factors are compiled in Table I. In order to use this tabulation it is first necessary to determine or select a suitable erythema

skin dose with one tube at 1 cm. distance from the skin. This chosen dose, multiplied by the factor for any combination of tubes at any particular distance, will give the S.E.D. for that combination and distance. Table II shows such a calculation using 300 mg.-hr. as an arbitrary skin dose at 1 centimeter.

Obviously it was not feasible to use this method of calculation for tubes arranged in tandem in parallel rows. Instead, we were forced to rely on ionization measurements only. We found, however, that the same conditions exist when more than two tubes are arranged in tandem and parallel as when the same number of tubes are arranged in parallel only. Table III gives the values obtained from measurements of four tubes in parallel (see Fig. 1-A) 2 cm. apart and 2 cm. Ra-S.D., and four tubes in tandem and parallel (see Fig. 1-B) as compared with

TABLE I.—FACTORS TO BE MULTIPLIED BY S.E.D. WITH ONE TUBE AT 1 CM. IN ORDER TO DETERMINE ERYTHEMA DOSES WITH VARIOUS NUMBERS OF TUBES AT VARIOUS DISTANCES

Parallel tubes 1 cm. apart²

Ra-S.D. (cm.)	Number of tubes						
	1	2	3	4	5	6	8
1	1.00	1.14	1.38	1.61	1.88	2.20	2.63
2	3.33	3.50	3.87	4.10	4.45	5.10	5.70
3	7.15	7.26	7.40	7.65	8.30	8.90	9.50

Parallel tubes 2 cm. apart³

Ra-S.D. (cm.)	Number of tubes								
	1	2	3	4	6	8	10	14	16
2	3.33	3.93	4.80	5.57	7.38	9.18	11.0	15.0	17.0
3	7.15	7.32	8.27	9.40	12.0	14.0	16.6	22.0	
4	11.8	12.0	13.25	14.5	17.7	20.4	23.5	30.7	
5	18.0	18.0	19.45	20.6	24.1	27.4	31.3	40.0	
6	25.0	25.1	26.5	27.8	31.4	35.0	39.5	50.0	

In order to obtain the factors at greater distances than 3 cm., when the tubes are spaced 1 cm. apart, use the factors in the lower half of the table under parallel tubes 2 cm. apart with half the number of tubes. *e.g.*, for Ra-S.D. 4 cm., 6 tubes spaced 1 cm. apart, use the factor under tubes spaced 2 cm. apart column headed 3 tubes, Ra-S.D. 4 centimeters.

²Approximate area at 1 cm. Ra-S.D. is 4 sq. cm. per tube. At greater distances the area becomes progressively greater.

³Approximate area at 2 cm. Ra-S.D. is 8 sq. cm. per tube. At greater distances the area becomes progressively greater.

TABLE II.—ERYTHEMA DOSES CALCULATED FROM FACTORS (TABLE I)
Parallel tubes 1 cm. apart

Number of tubes							
Ra-S.D.	1	2	3	4	5	6	8
(cm.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)
1	300	342	414	482	565	660	790
2	1,000	1,050	1,160	1,230	1,330	1,530	1,710
3	2,140	2,170	2,220	2,290	2,480	2,670	2,850

Parallel tubes 2 cm. apart

Number of tubes								
Ra-S.D.	1	2	3	4	6	8	10	14
(cm.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)	(mg.-hr.)
2	1,000	1,150	1,440	1,665	2,210	2,750	3,300	4,500
3	2,140	2,200	2,470	2,820	3,600	4,200	4,970	6,600
4	3,540	3,600	3,970	4,350	5,300	6,100	7,050	9,200
5	5,400	5,400	5,820	6,180	7,220	8,200	9,400	12,000
6	7,500	7,500	7,950	8,350	9,400	10,500	11,420	15,000

TABLE III

Depth	Measured values		Calculated values
	Tandem and parallel	Parallel	Parallel
2 cm.	100 per cent	100 per cent	100 per cent
3 cm.	60.8 per cent	60.0 per cent	59.0 per cent
4 cm.	38.7 per cent	39.0 per cent	38.4 per cent
5 cm.	26.9 per cent	27.8 per cent	27.0 per cent

TABLE IV.—DEPTH INTENSITIES

For 1 cm. Ra-S.D. Only				Tubes 1 cm. Apart				
No. of tubes	1	2	3	4	5	6	7	8
Depth (cm.)								
0	100%	100%	100%	100%	100%	100%	100%	100%
1	30.0	32.5	35.6	39.3	42.2	43.5	45.7	46.3
2	14.0	16.5	18.5	21.0	22.6	24.9	26.0	27.6
3	8.5	9.6	11.0	12.9	14.3	15.7	17.2	18.1
4	5.5	6.4	7.5	9.0	9.8	11.0	11.8	12.5
5	4.0	4.8	5.3	7.0	7.5	8.2	8.7	9.3

calculated values for four tubes in parallel (see Fig. 1-A).

Since wax has approximately the same absorption for gamma radiation as tissue

and was used in the ionization measurements from which the curve in Figure 4 was made, it is therefore permissible to use this curve to determine depth dosage. The meth-

od used in determining dosage factors as outlined in Figure 5 was repeated in order to determine the intensities at depth. Tables IV and V show the intensity at different dis-

the depth doses will be found on Table V, Ra-S.D. of 4 cm. with four tubes.

A departure from 1 mm. platinum filtration need not invalidate these charts, pro-

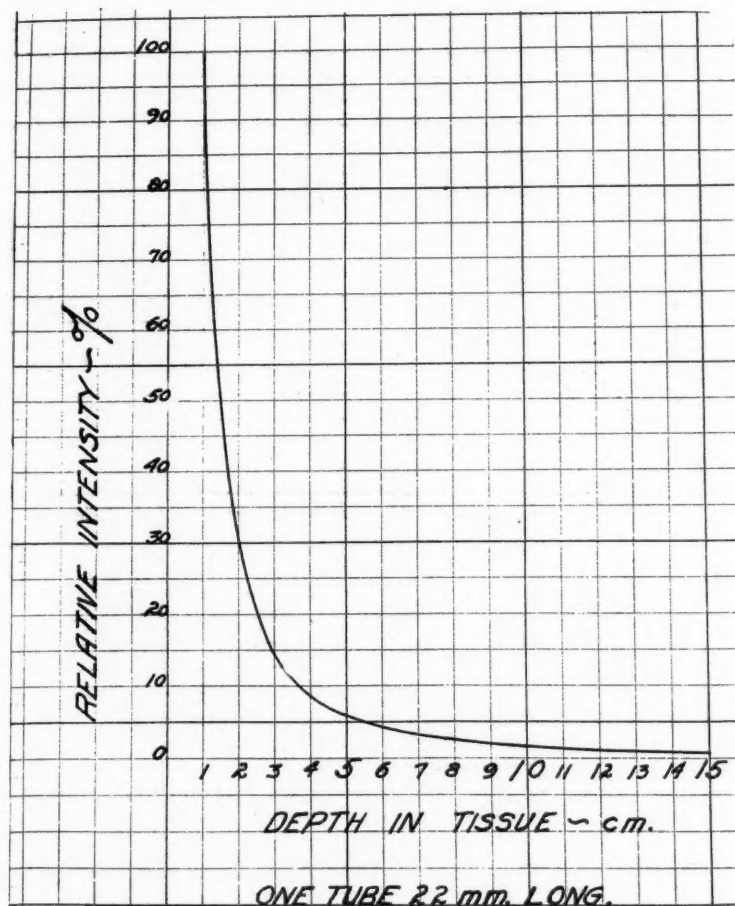


Fig. 4. This curve, drawn to a much larger scale than shown here, was used to calculate the intensities from various tubes at various distances.

tances below the skin, when the radium skin distance varies from 1 to 6 centimeters.

For greater radium-skin distances (Ra-S.D.) use depth charts, Table V as with half the number of tubes, i.e., for a Ra-S.D. of 4 cm. with eight tubes separated 1 cm.,

vided the filtration is sufficient to insure pure gamma radiation. Should the radium tubes be slightly longer or shorter than the ones used in these experiments, the surface and depth intensities would vary slightly from the values given.

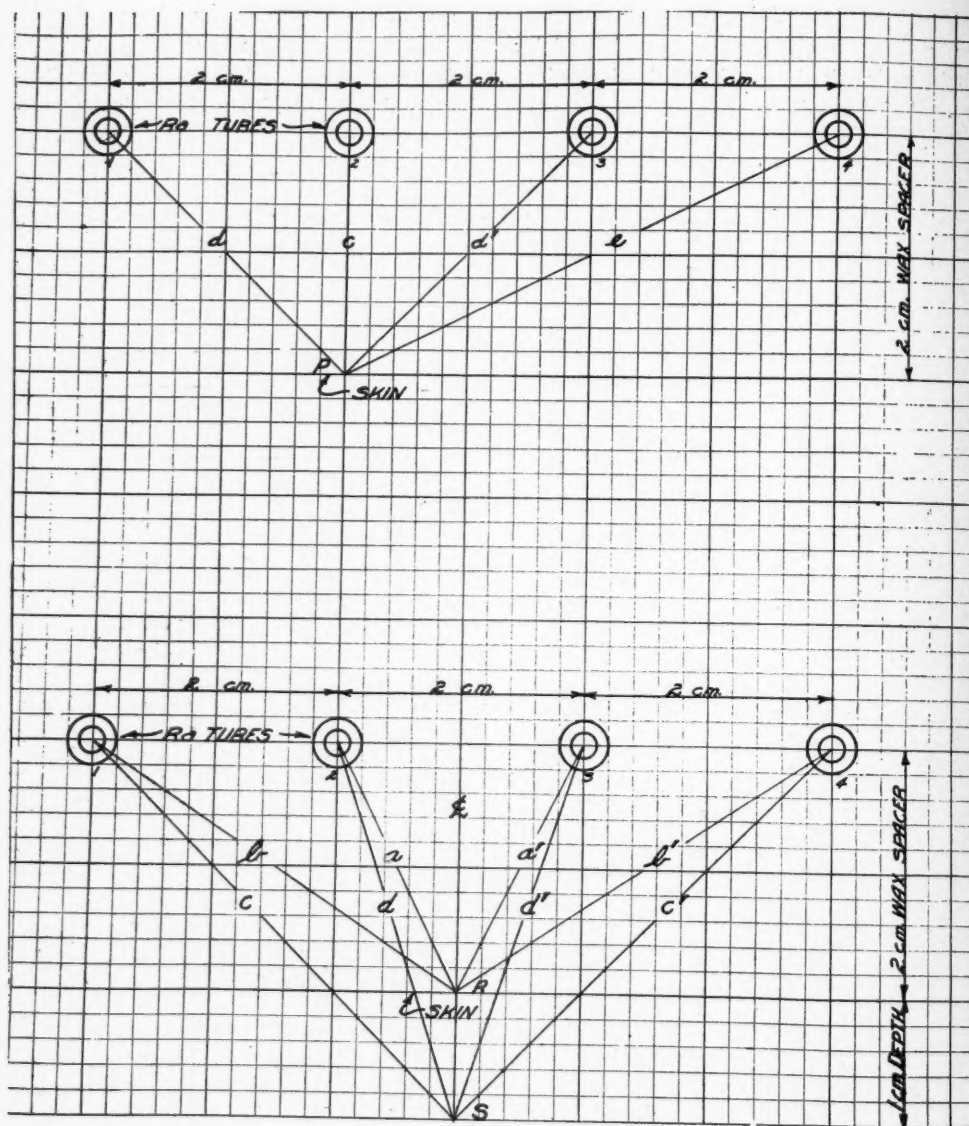


Fig. 5. Four points represent the midpoint of four parallel tubes placed 2 cm. apart and 2 cm. away from a line representing the skin.

SUMMARY

A photographic method is described which determines an even distribution of

radiation if radium is spaced not more than 1 cm. apart at 1 cm. Ra-S.D. or not more than 2 cm. apart at 2 cm. Ra-S.D. At greater radium-skin distances the tubes are

TABLE V.—DEPTH INTENSITIES

One tube						Two tubes, 2 cm. apart					
Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.	Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.
Depth						Depth					
0 cm.	100 %	100 %	100 %	100 %	100 %	0 cm.	100 %	100 %	100 %	100 %	100 %
1	46.6	60.8	65.2	72.5	75.0	1	53.7	61.0	66.8	72.0	74.5
2	28.3	39.7	47.5	54.2	61.2	2	32.6	40.8	48.4	53.6	59.9
3	18.5	28.7	35.4	44.4	50.0	3	21.8	29.3	35.9	43.1	48.4
4	13.4	21.5	29.0	36.3	42.5	4	15.7	21.8	28.8	34.9	39.5
5	10.0	17.6	23.7	30.8	33.6	5	11.7	17.6	23.3	28.4	32.5
6	8.2	14.4	20.2	24.3	29.8	6	9.4	14.2	19.0	23.4	29.9

Four tubes, 2 cm. apart						Six tubes, 2 cm. apart					
Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.	Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.
Depth						Depth					
0 cm.	100 %	100 %	100 %	100 %	100 %	0 cm.	100 %	100 %	100 %	100 %	100 %
1	59.0	65.0	70.3	74.0	76.5	1	61.7	67.6	73.4	76.6	77.5
2	38.4	45.8	52.2	56.7	61.0	2	41.7	49.6	56.4	59.4	62.5
3	27.0	33.9	39.8	45.2	50.0	3	30.6	38.1	43.7	48.0	51.9
4	20.0	25.9	31.8	37.2	41.0	4	23.5	29.5	35.3	39.8	43.4
5	15.3	20.7	26.1	30.4	38.5	5	18.2	23.8	29.2	33.3	36.6
6	12.2	17.0	21.4	25.6	30.5	6	14.7	19.8	24.4	28.1	31.9

Eight tubes, 2 cm. apart						Ten tubes, 2 cm. apart					
Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.	Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.
Depth						Depth					
0 cm.	100 %	100 %	100 %	100 %	100 %	0 cm.	100 %	100 %	100 %	100 %	100 %
1	65.1	69.2	74.4	77.6	78.2	1	66.3	70.2	75.4	79.0	81.0
2	45.0	51.5	58.2	61.2	63.0	2	46.7	58.1	59.6	63.9	66.6
3	33.5	40.3	45.5	49.2	52.3	3	35.2	41.0	48.4	52.6	55.8
4	26.2	31.5	36.7	40.9	44.3	4	27.8	33.9	39.6	44.0	48.2
5	20.5	25.7	30.5	34.6	38.5	5	22.5	27.8	33.2	38.1	41.4
6	16.5	21.0	25.8	30.2	34.0	6	19.5	23.4	28.7	32.7	36.5

Fourteen tubes, 2 cm. apart						
Ra-S.D.	2 cm.	3 cm.	4 cm.	5 cm.	6 cm.	
Depth						
0 cm.	100 %	100 %	100 %	100 %	100 %	
1	68.2	71.8	76.4	80.3	82.0	
2	49.0	54.8	61.2	65.8	68.7	
3	37.4	44.0	50.2	55.1	58.4	
4	30.0	36.1	42.0	46.0	50.0	
5	24.6	30.2	35.7	40.1	43.3	
6	20.6	25.6	30.6	34.8	38.0	

still spaced 2 cm. apart. A method which may be used to calculate depth doses at various Ra-S.D. is described and compared with measured values for the same. Tab-

ulations are given to be used in determining dosage with multiple points of radiation and intensity of radiation at different distances below the points of application.

RADIOTHERAPY WITH SMALL QUANTITIES OF RADIUM

By PAUL O. SNOKE, M.D., LANCASTER, PENNSYLVANIA

THE premise that large quantities of radium are essential to adequate therapy has gained wide acceptance. A perusal of the radiological literature creates the general impression that adequate radium therapy demands one-half gram of radium or more (the more the better), and that the use of smaller quantities in the treatment of malignancy is blameworthy and absurd. Credence has been lent to this assumption by the publication of reports from cancer centers where unusually large quantities of radium are in use.

If, however, we delve into the problem more deeply we find that excellent work can be accomplished with small quantities, and that the amount of radium necessary is dependent only upon the clinical material available. It is with this in mind that we venture this presentation.

Attempts to discover the geographic quantitative distribution of radium in the United States were ineffectual. No reliable figures are available, but in a general way we learned that approximately 75 grams of radium are now in the hands of the medical profession in this country. Saltzstein (2), in an article published in 1929, says, "In only three cities . . . were there larger amounts of radium than 100 and occasionally 200 milligrams." This statement was written after he had visited twenty cities, ranging in population from 100,000 to 1,250,000, five of which cities have medical schools.

It is evident that the quantity of radium available in many cities is far less than many physicians believe. The obvious paucity of the element renders such excellent scientific work as Duffy's (1), of only slight practical point, therefore, to the vast majority of the practising radiologists, with the exception, that purely scientific investigation

may point the way for the ingenious, radium-poor therapist to adapt scientific fact to practical problems. Obviously there is a great gulf fixed between radium therapy in twenty cities of the United States and in the several large scientific investigative centers. The bridging of this fixed gulf is most difficult, involving many factors.

When radium first became available as a therapeutic agent the surgeon saw his need for it, felt his responsibility to his patients, and, as he possessed the necessary capital, began its use. Little opportunity was afforded him for training in this field. Up to 1915, only twenty-three papers on radium therapy of carcinoma of the cervix had appeared in the world's literature and of these only seven were prepared by American physicians. In the three succeeding years little could be done because of the War, so that not much over a decade of active work has resulted. Meanwhile, the surgeons were bearing the brunt of the attack upon cancer, and contributing largely to scientific radiologic knowledge. We need only mention the names of Kelly, Janeway, Perthes, and Döderlein. On the other hand, the vast majority of the surgeons were using radium as a stop-gap in cases in which further surgery was impossible. The past decade has witnessed an adjustment of this deficiency, and now there are well-trained radiologists. The burden of the work of the next decade must fall upon these men, for they must adapt scientific fact to practical exigency.

THE LOCAL PROBLEM

The Lancaster General Hospital is a community hospital containing 225 beds, serving an urban population of 60,000, with a surrounding farming community of 250,000. Approximately a hundred physicians serve

these people. There is also another hospital of almost equal size in this city, and only sixty miles distant is a city of the first class.

By consulting the records of the Bureau of Health of the State of Pennsylvania, we ascertained that in 1928 there were 228 deaths from cancer in Lancaster County. Assuming that this represented one-third of the morbidity, it would mean that at any particular moment there were 680 persons suffering from cancer in this area. This morbidity figure (3) is open to grave question, as cancer is not a reportable disease, and, therefore, few figures are available. Hoffman (4) makes no statement concerning this matter.

We believe the assumption that the mortality from cancer is one-third of the morbidity is incorrect, erring on the high side for the following reasons: During the year 1928 there were 104 cases of cancer admitted to the Lancaster General Hospital, practically all of which were major surgical cases. During the same period 40 other cases were seen in the radiological department. Only about 50 per cent of the work in this community is taken care of by this hospital. It is a simple matter to compute from these figures the estimated 680 cases, forgetting those patients refusing hospitalization, treated by private physicians, hiding their disease, or incorrectly diagnosed.

Using the morbidity figure 680 as the sole available one, it is only fair to assume that 50 per cent of this group will be taken care of by one of the two city hospitals. If 50 per cent of the remaining patients apportioned to this hospital are untreatable by radium, we could expect to build about a group of 170 patients per year. It may be objected that 50 per cent is too high a figure for radium-irradiable patients. Nevertheless, many other diseases require radium therapy which can not be classified as cancer, such as the leukemias, angioma and skin diseases. Of this group, about 5 per cent (*i.e.*, the wealthy) will go elsewhere.

The income from the remaining 162 prospective patients must meet the interest on the investment, the insurance, and a reasonable salary to those handling the treatment.

The fixed charges are the interest on the initial radium investment of \$5,500 at 6 per cent, amounting to \$318 annually, and the insurance, which is approximately 2 per cent of the investment, or \$118. The insurance is a very necessary item, as the risk of loss is great. There are two forms of insurance: the form referred to here has the "supervision clause," requiring the supervision of a trained nurse during the use of the radium. This is the least expensive form; besides, the supervision of a nurse is advantageous from the radiologist's viewpoint, assuring him of accuracy in timing and positioning.

No depreciation is charged against this account, as the element has a half-life of 1,860 years. The applicators must be counted as an expense, but this item is not large, amounting to less than \$30 per annum. This gives us total fixed charges of \$466 per annum.

DISTRIBUTION OF RADIUM IN ORIGINAL CONTAINERS

In order to be of the greatest service, the radium must be in its most flexible form. Needless to say, a radium emanation plant is impracticable with smaller quantities of radium than one-half gram. Predicating the use of the element, two main methods of treatment must be made available:

- (1) Interstitial radiation
- (2) External application

We must, therefore, have needles and capsules.

With the funds available¹ we could purchase 75 milligrams of radium. It was decided to secure five 10-mg. steel needles and one 25-mg. capsule. The needles were secured for interstitial radiation; also, after

¹Made available through the courtesy of Dr. H. B. Davis.

enclosure in a brass capsule, for cervical or surface applications. The 25-mg. capsule was especially desired for enclosure in 0.5 mm. of Ag for surface application; also for use in a 1 or 2 mm. brass capsule for cervical or surface application.

Since this acquisition the work of Regaud (5) has been studied and we feel that better results can be obtained with greater filtration; so that we contemplate changing our five 10-mg. needles for ten 2-mg. platinum-iridium needles. This will release 25 milligrams for applicators.

TYPES OF CASES TREATABLE

There are several principles which must be firmly grasped before any therapy is undertaken. The patient must be made to understand that radiation therapy requires time—it is not a pill to be taken and forgotten. Cancer therapy is a matter of a week or more and the beneficial effects may not occur for months. Time is the cheapest thing the patient has to invest. The duration of treatment from the patient's viewpoint should be an inconsequential matter; it is to the therapist that the time factor is important. At the Curie Institute, in Paris, one month is required for the completion of a radiation cycle for carcinoma of the cervix.

Very little beta radiation is used in our work, preference being given to filtrations through 1 mm. brass, 2 mm. brass, or 3 mm. lead. The higher filtrations require longer treatment times. The highest filtration we use is 3.0 mm. of lead. Moulages of Columbia paste or dental compound are very advantageous.

Interstitial radiation finds its greatest use in intra-oral lesions, carcinoma of the breast (in cases in which operation is contra-indicated or impossible), and occasionally in carcinoma of the cervix.

Surface radiation is used more than any other method. Lesions in the intra-oral group can be irradiated by the application

of capsules on variously shaped handles fashioned from lead sheeting 2.0 mm. thick. A lead spoon may be used for applications to the hard palate, while the ordinary tonsil clamp can be used in carcinoma of the tonsil. Carcinomatous lesions of the skin are well fitted for this type of radiation, the silver tube being used for the more superficial types. In the more infiltrating types, distances up to 2.5 cm. are employed, obtained by cutting corks to the size and thickness desired. The exact technical details will be found in a later article.² The patient is usually hospitalized for three days if a large area is to be treated; for example, in the treatment of carcinoma of the thyroid fourteen areas are usually treated, the time required being 42 hours.

Carcinoma of the cervix uteri probably represents the most frequently irradiated site and the most ideal one for this type of work. The brass capsules are used for the intra-cervical applications and the technic of Bowing (6) followed with minor modifications. The results are not in direct proportion to the quantity of radium used, but depend upon the wisdom of the radiologist, and his technic. A great deal of attention is given to the accurate measurement of lesions, or the drawing of them to scale and planning on these drawings the various fields to be treated. Photographs and biopsy records are kept of each patient, so that at any time a complete record is at hand. Notes of the progress of the case are made at frequent intervals and are of great importance in case reviews.

CONCLUSIONS

Radiotherapeutic results depend upon the training and ingeniousness of the radiologist, and not entirely upon the quantity of radium available. The radium requirements of any institution or community can be determined within the limits of financial safe-

²A second paper, on technic, will be published soon.

ty by a consideration of the factors involved. It is neither practical nor necessary that large quantities of radium should be available, for the mere possession of a half-gram of radium is no guarantee that the patient will receive sufficient treatment.

An adequately trained radiologist is more to be desired than radium, yea, than much fine radium, if you will pardon a paraphrase. The effectual use of radium demands the supervision of one man so trained; unless this is done, therapy is a haphazard matter, without definite beginning or ending, and efficiency in the use of the element is impractical, for radium should work twenty-four hours each day when the clinical material is available. It is not to be expected that the surgeon will meet in his practice those patients with skin diseases amenable to radium therapy, nor will he see the blood dyscrasias which perplex the internist; but the respective specialists will each know those diseases in his field which are suitable for radium irradiation—the surgeon his sarcomas, the gynecologist

his carcinomas of the cervix, the internist his leukemias, the dermatologist his hemangiomas. The radiologist, drawing from these sources, finds daily use for his radium, and knows the multiplicity of technical details so essential to successful treatment.

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RADIOTHERAPY IN CHRONIC MYELOGENOUS LEUKEMIA¹

By ROY G. GILES, A.B., M.D., TEMPLE, TEXAS

LEUKEMIA has presented many interesting and perplexing problems since the independent account of this malady by John Hughes Bennett (1) and Rudolph Virchow (32) in 1845. Chronic myelogenous leukemia is a disease of the blood-forming tissues, of unknown origin, the characteristic findings of which are: a great increase in the white cells; an increase in the pathological cells, especially the myelocytes in the circulating blood, and a secondary anemia, accompanied by varying degrees of splenic and glandular enlargement.

The majority of cases of chronic myelogenous leukemia, 55 per cent, according to Minot (16), occur between the ages of thirty and fifty years. There is a sharp drop in the incidence of the disease after the age of sixty; however, occasional cases are reported in elderly persons. Ordway and Gorham (18) observed chronic myelogenous leukemia in a woman seventy-five years of age. It is a rare malady before the sixth year, but there are several carefully studied cases of myelogenous leukemia in infants. Up to 1925, Steinbrink (28) had noted only 33 cases in young individuals. In 1927, Ramsay (23) analyzed 19 cases in infants.

The therapeutic measures for the treatment of leukemia were, for the most part, symptomatic and directed against the associated anemia until relatively recent years, when it was discovered empirically that certain agents have a more or less specific effect in reducing the greatly increased number of white cells. Therefore, modern treatment is directed not only toward the secondary anemia, but toward the leukemia.

The general management of patients suf-

fering with chronic leukemia should include the best possible hygiene, outdoor life with its fresh air and sunlight, and exercise regulated to the strength of the individual patient. The diet should be adjusted to the requirements of the patient, consisting in many cases chiefly of fruits, vegetables, and milk. Physiotherapy, especially in the form of tonic ultra-violet ray, may exert a beneficial influence on the general well-being of the patient. We should not neglect medicinal measures such as iron and arsenic in their various forms. Transfusions, red bone marrow, and colloidal metals have been advocated.

Spontaneous remissions occur normally but rarely in chronic myelogenous leukemia. Minot, Buckman, and Isaacs (16) observed definite spontaneous moderate remissions in 7.7 per cent of 52 non-irradiated cases. Untreated cases are slowly progressive, and usually have a slow downfall, though the patient may remain for a long time in a poor state of health. The measures which have been directed toward the treatment of leukemia are splenectomy, benzol, roentgen ray, radium, thorium, and some of the other radio-active preparations. These remedies have been used to bring about remissions in the chronic type of the disease, but acute leukemia is apparently influenced very little, if at all, by any type of treatment.

Splenectomy was the first measure directed toward the treatment of leukemia. The first case of removal of the spleen for myelogenous leukemia was reported by Bryant (3) in 1866. The patient, who had a very large spleen, was in poor general condition and died soon after the operation. Giffin (9b) states splenectomies were performed, not infrequently, during the period from 1866 to 1900. According to him, the

¹Read before the Radiological Society of North America, at the Sixteenth Annual Meeting at Los Angeles, Dec. 1-5, 1930.

total number reported in the literature to January 1, 1918, is 51, with temporary recovery in eight cases. This indicates an operative mortality of 86 per cent.

W. J. Mayo (15c) reports they have found that, after the size of the spleen has been reduced by radium or X-rays, a splenectomy can be performed with comparatively little risk. During the period from April 1, 1904, to March 1, 1928, Mayo reported that splenectomies were performed in 500 cases, with a mortality rate of 10 per cent. Of these 500 cases, 45 had the spleen removed for myelogenous leukemia, with an operative mortality of only 6.6 per cent. Radium or X-rays were used prior to the operation to reduce the white count and the size of the spleen. The mortality rate was lower in the cases of myelogenous leukemia prepared by radium or X-rays before the removal of the spleen than the average for splenectomy in general.

Giffin (9b) states:

Patients who have had the disease apparently less than a year, and especially less than six months, and do not show any evidence of acute exacerbations, can be promised prolongation of life, and better general health, with a fair degree of confidence.

He sums up the status of removal of the spleen as follows (9b, 9c): "It is thus concluded that splenectomy is warranted in certain cases of myelogenous leukemia, though it is not to be urged." Norris and Farley (17) believe that the only reason for surgery is removal of the spleen to relieve weight and pressure. Removal of the spleen does not alter the course of the disease, since the blood formula remains qualitatively leukemic following splenectomy. It is a measure, therefore, to be used only in the exceptional case.

According to Miller (15d), Santassen, in 1897, first noticed that there was a reduction in the total leukocyte count, with a corre-

sponding reduction of red blood cells, in persons using benzol in a bicycle factory. The leukotoxic action of benzol was confirmed in 1910 by Selling (26). This action suggested its use in leukemia, the first practical application being made by Koranyi (12) in 1912, with a marked reduction in the blood picture. Benzol is a specific bone poison, affecting the cells that produce the red corpuscles, as well as those producing the leukocytes, thus causing an increase in the associated anemia. In addition, benzol is markedly toxic, producing disagreeable symptoms, occasionally followed by sudden death. Therefore, it is not used to any great extent at the present time in the treatment of leukemia.

Senn (27), in 1903, first undertook the treatment of leukemia by means of the X-rays. Pancoast (20), Roth (25), Renon, Degrais and Desbouis (24), Ordway (19), Peabody (21), Giffin (9a), Vogel (33), Wood (35), Levin (14), Oppenheimer (22), Stern (29), Gulland (11) and others were among the early observers to point out the dramatic drop in the white blood cells when a case of myelogenous leukemia was treated with X-rays or radium. It was not until Renon, Degrais, and Desbouis (24), in 1913, and Peabody (21) and Ordway (19), in 1917, reported the effect of radium on the disease that adequate irradiation was given at sufficiently frequent intervals to produce marked alleviation of symptoms.

The action of roentgen and (16b) radium rays upon the normal circulating blood consists of an initial leukocytosis bearing chiefly on the polymorphonuclear cells. The leukocytosis lasts for from a few hours to two or three days and is followed by a leukopenia which steadily increases and lasts for from two to four days. Regeneration of the elements of the blood takes place following large doses as well as small. The influence of irradiation on the blood is determined by the size, intensity, and character of the dose, larger doses producing greater changes

than smaller ones. Patients treated over the spleen, chest, abdomen, and pelvis show the most pronounced reaction. The action of radium and X-rays on the blood is similar, but because the surface or area exposed to radium is generally smaller, the reaction is less pronounced. The chief effect of irradiation on the normal spleen and lymph nodes is limited to the destruction of lymphocytes, and is much more pronounced when these structures are in a state of hyperplasia from any cause. In the case of exposure of equal body surfaces to radium or X-rays, the action of the radium is more intense than that of the X-rays, and subsequently more extensive replacement of connective tissue results.

The effect on the blood-forming organs is made use of in the treatment of certain diseases of the blood, spleen, and lymph nodes. In the treatment of leukemia, the great capacity of irradiation to destroy lymphocytes and to produce leukopenia is valuable, because the leukocytosis produced by this disease can thus be greatly reduced. The treatment is largely concentrated on the spleen in the myelogenous type, but if this is not sufficient, the effect can be increased by treating the marrow of the long bones.

Strumia (30, 31), in discussing the effect of radium applications on the morphology of the blood in myelogenous leukemia, reached the following conclusion:

The mechanism of action of radium upon the leukemic foci is of generalized as well as of localized nature. That is, when radium is applied to any portion of the body, its effect is carried by the blood stream to the leukopoietic foci. Thus from a local application a generalized effect is obtained.

Our experience in 25 cases seems to indicate that the effect obtained is in proportion to the number of square centimeters of skin surface irradiated, and upon the size, intensity, and character of the dose. Large doses

produce greater changes upon the normal circulating blood as well as upon the abnormal blood.

The leukemias are characterized by a natural progression to a fatal end, in spite of all treatment. The rate of advance is subject to wide variations, some cases being much more acute than others. Minot (16) expressed the opinion that those individuals destined to have a short duration of life usually have a stormy and impressive onset of symptoms, which lead to earlier diagnosis and treatment than in the more chronic cases of myelogenous leukemia.

The average duration of life in 102 cases treated by Fricke (8) at the Howard A. Kelly Hospital was one and one-half years. Minot (16) and associates studied the records of 166 cases of chronic myelogenous leukemia, and found that the average length of time between the appearance of symptoms and diagnosis was 1.4 year, and that the average duration of life was about 2.5 years.

Irradiation is the treatment of choice, as it maintains the efficiency of the patient to a greater extent than any other known remedy. In most cases it produces remission from symptoms and reduces the high leukocyte count. Minot (16) found that 50 per cent of the patients, some of whom were bed-ridden, improved sufficiently to permit them to resume their activities. He claims increased efficiency of the patient whether therapy is administered early or late in the course of the disease. Forssell (7) and Walterhofer (34) claim that definite improvement takes place in 90 per cent of the cases of myelogenous leukemia receiving adequate irradiation. Remissions are obtained by irradiation applied over the spleen, over the marrow of the long bones, or in both places. The most rapid remissions are unquestionably obtained by treatment over the spleen, chest, abdomen, and pelvis, because the total area irradiated is greater and the total dose is more intense. Following

irradiation over the spleen or marrow of the long bones, a rapid fall in the number of leukocytes is noted. There is also a decrease in the size of the spleen, but not in proportion to the leukocyte count. The red blood count and the percentage of hemoglobin improve, and there is also a rapid improvement in the general condition of the patient.

Every case of myelogenous leukemia has its own peculiarities with regard to severity, rapidity of change, and response to treatment. The blood picture and the general condition of the patient should be observed before each application of X-ray or radium. The frequency of irradiation is a very important factor in the treatment of leukemia, and the leukocyte count should not be depressed below twenty or thirty thousand. Treatment given early in a recurrence is more likely to be effective than after the change has become well established, and improvement may be obtained by a relatively small amount of treatment as compared to the quantity of irradiation required after the recurrence has become well established.

The remissions may last for a few months or even years. There is always a recurrence and subsequent remissions are increasingly difficult to obtain. Following irradiation the manner in which the remissions occur and the real underlying reason are obscure. The bone marrow itself is the seat of the pathologic process, and it is a matter of conjecture how irradiation to the spleen exerts so powerful a depressing influence on the white cell elements in the remote bone marrow. As a rule the leukoblastic tissue is very susceptible to the influence of X-ray or radium, but the effect is not a direct one, because the treatment applied to the long bones themselves is usually not so effective as that given over the spleen. Irradiation of short wave lengths produced by either X-rays or radium furnishes a more penetrating ray and the effects of treatment are more

quickly seen. The less penetrating effect of long wave length X-rays requires a little longer time to produce the same result. It is true that marked symptomatic improvement and immediate reduction of the white cell count rapidly follow the application of intensive massive doses of X-rays or radium. However, there is no definite evidence at the present time to support the view that strong initial irradiation of short wave length will postpone recurrences any further, or give greater relief in the interval of freedom, than is obtained with rays of only moderate penetration and intensity. Leukemic patients develop a tolerance to irradiation, and, as time goes on, a more penetrating ray, longer course of treatment, and longer intervals between treatments are necessary.

There is as yet no optimum dose of X-rays or radium for the correct treatment of leukemia, each therapist emphasizing his individual technic almost to the exclusion of all others. We advise moderate doses of X-rays, repeated at intervals as indicated by the leukocyte count, and the general well-being of the patient. A number of radiotherapists advocate this method of irradiation. It must be remembered that intensive short wave length irradiation, whether from the gamma rays of radium or high voltage X-rays, gives relief only. One must also remember that the system builds an immunity against these intensive short wave length rays, so that after several treatments the intensive short wave length therapy fails to produce the desired remissions. Therefore we deem it safer to start with the longer wave length X-rays (*i.e.*, 80 to 100 K.V. filtered through 3 to 4 mm. of aluminum, depending upon whether treating over spleen or long bones), over the spleen, chest, or long bones, reserving the heavier forms of irradiation from radium or X-rays until the inevitable time when the lighter forms of irradiation have exhausted their usefulness. In other words, the smallest effective dose

should be used until experience indicates that the more intense shorter wave length type of irradiation is necessary.

It should be remembered that the treatment of leukemia with X-rays or radium offers more hope than any other known therapeutic agent. No matter whether long wave length X-rays with moderate intensity, or high voltage short wave length X-rays, or the gamma rays of radium with great penetrating power and intensity are used, palliation is all that can be offered patients suffering with chronic myelogenous leukemia. The technic described gives remissions from symptoms. The writer has been immensely gratified to note, on more than one occasion, that, after the disease finally becomes refractory to the longer wave length X-rays, the more penetrating short wave length rays of either roentgen or gamma rays of radium in the form of great intensity and large doses (when necessary) can be depended upon, for a while at least, to give further remission from symptoms.

There is the greatest need for illuminating knowledge on the subject of the best form of treatment of myelogenous leukemia. We are hopeful that an optimum dosage will ultimately be arrived at for the correct treatment of the disease.

CASE REPORTS

Case 1. Miss G. S., graduate nurse, aged 28. She had had the usual childhood diseases, also pneumonia at the age of 10, and typhoid at 18 years of age. She had an appendectomy in 1919 at the age of 24, at which time the leukocyte count was 15,350. Three months later her blood count was taken and was found normal. In December, 1921, the patient had a cholecystectomy and a large duodenal ulcer cauterized. In July, 1925, her first elevation of the leukocyte count was noted other than the one due to her appendix. From July to October, 1925, her leukocyte count varied from

15,000 to 31,000, and there was frequently an increase in the number of myelocytes as high as 15 per cent, and many were of the basophilic type.

This case was of unusual interest because of the peculiar blood findings, together with the clinical findings, such as slightly palpable spleen, nausea, gas, vomiting, pain, and headaches, long before the presence of characteristic findings of myelogenous leukemia appeared. A definite diagnosis of leukemia was made when the blood count in February, 1926, reached above 62,000, with an associated increase in the myelocytes and basophilic myelocytes. The patient received fifteen applications of radium over the spleen from February 14, 1926, to October 15, 1927, and three treatments of low voltage X-rays over the long bones.

This case is presented because it shows the clinical symptoms and blood findings in an early case of leukemia. The diagnosis was made or suspected very early. The blood count was rather low all during the course of the disease, at no time being above 70,000. During the last sixty days there was a deficiency in the proportion of leukocytes in the blood, ranging from 1,100 to 2,000 white cells per cubic millimeter, presenting a typical aleukemic phase of leukemia. Duration of life was two years, five months, and two days.

Autopsy Findings.—In order to shorten this report the non-essentials will be dispensed with.

Diagnosis: (1) Hypostatic pneumonia (terminal); (2) Splenomyelogenous leukemia.

The lungs showed some groups of cells, myeloid in character. The capillaries and vessels of the interlobar spaces of the liver were filled with large irregular cells, apparently of myeloblastic origin.

The spleen was markedly enlarged, measuring $24 \times 12 \times 9$ cm. in diameter and weighing 1,000 grams. Capsule of spleen

4. Spontaneous remission occurs normally but in a very small percentage of cases.

5. Splenectomy does not modify the evolution of the disease and for this reason is not superior in its effect to irradiation. Irradiation brings the blood formula to or near normal for a longer or shorter period, whereas following splenectomy the blood count remains qualitatively leukemic.

6. Irradiation of the spleen has been considered the most effective therapy of chronic myeloid leukemia since Senn, in 1903, observed that roentgen irradiation effected a reduction in the enlargement of the spleen, and an improvement in the blood picture.

7. The effects of irradiation are only temporary and recurrences develop.

8. Renewed irradiations will improve the recurrences. The frequency of treatment should be controlled by leukocytic determinations, which should not show a depression below 30,000.

9. Radium or X-ray treatments cause more or less replacement by connective tissue; the spleen develops a resistance to irradiation, and finally the radiotherapy becomes entirely ineffective.

10. The smallest effective dose should be determined and used until observation shows that a heavier form of irradiation is indicated.

11. There is the greatest need for an optimum dose for the correct treatment of myelogenous leukemia.

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DISCUSSION

DR. R. S. STONE (San Francisco): We are very much indebted to Dr. Giles for bringing this subject before us again. It is constantly interesting, and although very few of us have any number of these cases to treat, they are always of great interest. Dr. Giles has passed over the question of intravenous thorium and radium treatments. If you recall, some years ago, Dr. Rollin H. Stevens, with whom I was associated at the time, read a paper before this Society on the use of radium chloride intravenously, at which time we were having some success in giving it to patients who had reached the stage shown in the last chart presented by Dr. Giles—when somewhat X-ray-resistant. At that time the use of intravenous radium chloride seemed to bring the patient back. I have had a rather sad experience with that method since I came out to California. We had a patient who became X-ray-resistant and was running a white count of 650,000, but feeling well and going about

her daily work. However, we thought that count was a little high for a patient to go around with, so we gave her 25 micrograms of radium chloride intravenously, whereupon she promptly went into the hospital and has been almost *in extremis* since. I do not know how much the radium chloride had to do with bringing on this condition which 650,000 cells in itself could bring on. I have not yet given up hope that intravenous radium will prove useful.

It is generally stated that we should govern our dosage of therapy by the number of white cells in the blood stream, and that, as I gather, is one of the controlling factors that Dr. Giles brought before us this morning. I think, however, we must realize that it is a question not only of quantity but of quality, and that one may have a patient with 3,000 white cells, practically all of them abnormal, who needs treatment worse than another patient with 30,000 cells, most of them of the adult type of leukocyte. So I think we need more study of our X-ray treatment of these conditions, basing the treatment on the type of cell present in the blood stream.

DR. H. A. SPILMAN (Ottumwa, Iowa): I have not had a large experience in myelogenous leukemia, but there is one case that has come under my attention for relief from gastro-intestinal symptoms—he was absolutely positive that he had a gastric carcinoma. When he came in the blood count was discovered to be seventy to eighty thousand, characteristically myelogenous leukemic in type. There is a question involved in this case which may arise in other cases, in that the patient has had a pyelitis for many years and has had a prostatotomy to improve the drainage, so there has been a decided difference of opinion for a considerable time as to whether or not it is a true leukemia. Slides have been sent to Dr. Minot and to numerous places, and the consensus of opinion is that it is a myelogenous leukemia. The patient has responded to moderate doses, but there has been recurrence of the gastro-intestinal symptoms. Another feature has been the absence of any palpable enlargement of the spleen. This re-

port is based not only upon my own examination and that of my associates, but of men in larger centers who have had greater opportunities of seeing these cases.

There was another case which we had the opportunity to observe for a period of seven years following a splenectomy. This patient has died within the past few months. Radiation therapy was able to keep his count down. I personally do not feel that the exact number of white cells is as important as the *feeling* of the patient: It is upon that that we govern our treatment in these cases.

DR. JAMES M. MARTIN (Dallas, Texas): I want to compliment the essayist. Dr. Giles is a pupil of mine and we are proud of him down in Texas. I want to mention two cases, with both of which Dr. Giles is familiar. One was a nurse and the other a soldier and they were both stricken with myelogenous leukemia overseas during the World War. They were treated along the lines that Dr. Giles has outlined. Improvement was rapid at first and they were able to go about their regular work. The soldier was a printer and worked at his trade in comparative comfort to the time of his death eighteen months after treatment was begun. While the nurse made rapid improvement, she was not allowed to do any fatiguing work; she was comfortable and able to go about as she pleased until diarrhea became a complication. She lived two years and four months from the time treatment was instituted.

While radiation therapy cannot cure this disease, it does relieve the symptoms and prolong life for varying periods of time.

DR. FRANK E. BUTLER (Portland, Oregon): I have treated several cases of myelogenous leukemia very successfully. I think of one patient with a white count of 1,250,000, who cleared up with therapy and was able to carry on his work for five years before death.

The point which I wish to emphasize is not to over-treat. I recall one case which I over-treated. The myelocytes completely disappeared and the patient started to have hemorrhage. We finally succeeded in checking it,

but nearly lost the patient as the result of too much treatment.

In all these cases the blood count should be watched carefully and the treatments given in small doses a few days apart so as to avoid over-radiation.

DR. WILLIAM H. SARGENT (Oakland, California): It may be of interest to report a case recently treated at the Highland Hospital, in Oakland. The patient was a woman about 29 years of age in whom the disease was found between the second and third months of pregnancy. The white count was 250,000, myelocytes 24 per cent. The questions which arose in this case were whether or not the X-ray treatments would injure the fetus and whether pregnancy should be interrupted. X-ray treatments were decided upon and given as follows: One-tenth of an erythema dose applied over the entire posterior chest, but directed more particularly over the spleen. The lower abdomen and back were covered to protect the pregnant uterus. In five days the leukocyte count dropped 4,000. The dose was then increased slightly and given thereafter at from five- to seven-day intervals until the count reached about 20,000. From then on, small doses at intervals of two weeks reduced the cells to 8,000 and held them there. Pregnancy went to term and a normal child was delivered. For four weeks before and eight weeks after confinement no treatments were given—a total of about three months. The white cells had again increased to 90,000, with 10 per cent myelocytes. The same small doses again reduced them to around 8,000, but from 1 to 2 per cent myelocytes persisted. In this particular case the X-ray treatments did no apparent harm to the fetus, even though started in the early months of pregnancy.

A MEMBER: I would like to ask the essayist a question: How soon after therapy and blood displacement do you expect beneficial changes in the blood?

DR. GILES (closing): As I have had no experience with the intravenous chloride treatment of these cases, I was glad that Dr.

Stone spoke of this type of treatment. Leukemia responds more readily to the short wave length X-rays or radium than to the longer wave length type of radiation. The response to treatment depends on the size, character, and intensity of the radiation dose.

The question of sufficient treatment is often difficult to determine, but, as Dr. Butler brought out, over-treatment may do as much harm to these patients as under-treatment. Over-treatment is to be avoided because it

contributes nothing to the temporary improvement and may make subsequent remissions more difficult to obtain.

The white blood count, the myelocytes, and the myeloblasts constitute a good index to the activity of the disease and a guide to further treatments. The smallest effective dose necessary to reduce the blood count in myelogenous leukemia is recommended, and then just enough to keep it approximately within the range at which the patient feels the best.

EPILEPSY DIET PROVOKES PELLAGRA

New light has been shed on the epilepsy problem which may lead to discovery of a cure for this baffling disease, or at least to a knowledge of its cause, as a result of a discovery by Dr. N. P. Walker, Director of the Milledgeville State Hospital, Georgia, and Dr. G. A. Wheeler, of the U. S. Public Health Service, Washington, D. C.

Dr. Walker observed that sufferers from epilepsy, when fed a high-fat diet, were benefited as far as the epilepsy was concerned, but developed pellagra, the "hard-times disease" which is believed to be due to a lack of Vitamin G in the diet.

In collaboration with Dr. Wheeler, Dr. Walker studied ten women patients suffering

from epilepsy. He found that when they were fed a diet nearly completely lacking in Vitamin G but otherwise complete in all respects, the number of epileptic seizures was greatly reduced and the nervous symptoms due to the epilepsy also improved. However, the patients developed pellagra while on this diet. When the pellagra was relieved by feeding yeast, a rich source of the anti-pellagra vitamin, the epilepsy became worse.

No conclusions can be drawn from these observations, and it is not suggested by Dr. Walker and Dr. Wheeler that pellagra be used to treat epilepsy, as malaria is used for treating paresis. However, their study points the way for further research on epilepsy which may yield final solution of the problem.—*Science Service.*

CLINICAL AND EXPERIMENTAL OBSERVATIONS RELATIVE TO THE ETIOLOGY OF CANCER¹

By MONTROSE T. BURROWS, M.D., PASADENA, CALIFORNIA

I WISH to describe in this paper some recent experiences in the treatment of carcinomas of the breast, skin, and lip in cases in which these lesions have been studied and treated as the direct result of some local, followed by some general, deterioration of the organism.

In a former paper before this Society, and elsewhere, it has been pointed out that one of the striking differences between malignant tissues and normal tissues is the deficiency of the fat-soluble growth-promoting vitamins in the former tissues. In other studies with the tissue culture it has been shown that differentiation is associated with the accumulation of certain lipid substances in the tissues. With the accumulation of these lipid substances within the cells and the intercellular substances the ability of these cells to grow in a plasma culture decreases proportionately. If means are provided for the removal of these lipid substances, growth then intervenes readily in these same differentiated cells. Careful feeding experiments were then undertaken to determine the fat-soluble vitamin content of embryos of various ages. These experiments indicate that the growth-promoting fat-soluble vitamin content of the tissues varies directly as the content of this growth-inhibiting lipid substance varies in these same tissues (1) (2).

That cancer may be the direct result of the removal of these fat-soluble vitamins from small areas of tissue in the body seemed, therefore, to be a logical conclusion from these experiments. In further proof of this idea it has been shown that certain lipid solvents such as coal tar, etc., when

applied repeatedly to an area of tissue in certain animals, will induce a malignant growth. In later experiments Ernst, Jorstad, and I were able to show that X-rays act in a similar manner. The coal tar evidently induces cancer in that it dissolves the lipid substances and removes them from the tissues. X-rays act differently. They liberate the vitamins from the tissues and cells so that they can be taken up and removed from tissues by other cells of the organism (3).

In still other experiments, I was able to show that an injury leading to an overgrowth of cells might also produce these same changes (4) (5). The cells of the body when placed in a drop of plasma do not grow at the expense of the plasma but at the expense of other cells in the culture. The plasma acts only to dissolve and remove the excess of lipid inhibitor from about the cells. The border cells of a fragment of tissue brought thus in contact with the plasma grow actively at the expense of the more central cells of the fragment. On studying more carefully the tissues most suitable for food for other cells, it has been found that for any group of cells to nourish other cells it is necessary that that group of cells shall contain an ample quantity of the fat-soluble growth-promoting vitamin. Body cells are apparently dependent upon this lipid for building the lipid of their protoplasm. As these cells are dependent for their growth upon fat and protein supplied from external sources, so they are dependent also upon properly synthesized lipoids for the building of their protoplasm. These lipoids are obtained as the fat-soluble vitamins of the food, and as they accumulate in the intercellular substances they act

¹Presented before the Sixteenth Annual Meeting of the Radiological Society of North America at Los Angeles, Dec. 3, 1930.

to inhibit growth and induce differentiation in these cells (6).

Abnormal stimulation of a tissue or a part leads to the use of much of the excess of this vitamin for the building of new cells and removes it from the intercellular areas. Lesions are thus produced which are quite similar to those produced by X-rays and coal tar.

From the latter observations it became evident, therefore, that any repeated injury leading to growth and repair might exhaust this tissue of its normal growth-inhibiting lipid and produce a typical precancerous area. Any break in the normal hormone balance in the organism might also excite abnormal growth in an organ or tissue and eventually lead to the same changes.

A SYSTEMIC FACTOR

In a further careful study of the action of coal tar it was noticed that, when coal tar is applied to the skin of an animal, the animal suffers not only from the local irritating effect but also from a general systemic deterioration which may be the result of a general decrease in fat-soluble vitamin content of the animal (7). It suffers a true cachexia not different from that seen in cancer. In mice, this cachexia always precedes the development of cancer. In rats, a cancer rarely ever develops. The rats, on the other hand, die sooner or later in cachexia after the beginning of the application of the tar. The same is true of the rats treated with X-rays.

We wondered then whether there might not be a systemic factor as important as the local factor in the development of cancers. About this time it was our good fortune to make an observation which not only indicated that this might be the case, but that this cachexia might be produced also by conditions quite different from those inducing the local lesion. A member of the

laboratory staff decided to place herself on a deficient dietary. She chose chopped meat and vegetables as food. This food she boiled twice, pouring the water off after each boiling. She knew that she had a very small tumor under the skin of her arm which had come after an injection of camphor in oil eleven years previously. She had forgotten, however, about this tumor. After three weeks on the above diet this tumor was as large as a walnut and she could not move her arm. A good dietary, including ample butter fat and cod liver oil, restored this tumor to its former size in one week. We removed it and found it to be a typical camphor oil tumor (8).

It was these facts which led me to believe, therefore, that spontaneous cancer might be due always to two factors, a local lesion and a general drop in the nutrition of the whole. This idea seems logical because it is most unlikely that any cell or group of cells can develop sufficient energy to overcome the energy of the cells about them in a normal organism unless these cells have suffered a preliminary period of growth and adaptation.² On the other hand, if these cells about them are injured first, so that their resistance is lowered, then this growth might take place most readily. It had thus become of interest to study cancer cases more carefully with this idea in view.

EARLY STUDIES OF CANCERS IN MAN

After beginning a study of cancer cases in California in 1928, we appreciated that such a study might be most productive of results because very few such studies had been made. Hysteria among the laity had led the physician to rush madly for some means to treat the cancer. He had expended his energies almost entirely upon finding some new means of removing or

²Transplantable tumors are well developed spontaneous cancers and their ability to continue growth in normal parts increases with each succeeding early transplant.

destroying this growth, and had forgotten all about the other ailments from which these patients might be suffering at the same time.

While all of our studies have indicated that nutritional disturbances are at the bottom of cancerous processes, there is no reason to believe that these nutritional disturbances are caused always by a lack of food. In fact, the American public as a whole is well fed, except perhaps for a certain lack in certain fat-soluble vitamins. This latter deficiency is not so striking, however, as many authors would lead us to believe.

As must be pointed out clearly here, however, the nutrition of a patient is determined not alone by his food intake but also by his ability to use this food. Various toxic conditions may prevent the proper utilization of any dietary. I have had many anemic patients come to my office for advice, telling me that they have adhered strictly to a good dietary, without results. The removal of a single dead and abscessed tooth was sufficient to cure many of these patients within a few weeks. An infected but symptomless tonsil, appendix, or gall bladder may have been the offending agent in other cases.

CANCER A SYMPTOM OF SYSTEMIC AND LOCAL DETERIORATION

With these particular ideas in view, I reported the first 43 cases studied (9). I reported these cases because the results were striking and it had been stated that cancer develops often in otherwise normal individuals. In each of the 43 cases I found the cancer developing not only on a previously existing lesion but always after the patient had suffered first from a definite disturbance, often quite distant, which caused a drop in his general nutrition. In only eight of these cases could I account for the drop

in the general nutrition by deliberate or forced starvation: the remainder were well fed. Their cachexia had developed from other causes. Dead and abscessed teeth could have accounted for the cachexia in 22 of these cases; poor dietary in the treatment of diabetes accounted for the cachexia in two other cases. In eight cases there was a recurrence of tertiary syphilis, together with dead and abscessed teeth. Starvation, with gastric disturbances lasting over two years, was present in two cases of gastric cancer. Chronic prostatitis, with arthritis and chronic tonsilitis and a kidney lesion, was present in two cases. The local lesions in these cases were found in the breast, stomach, skin, lip, tongue, cervix, uterus, and intestines. The cause of these lesions could be traced to chronic infections, hormone imbalances, mechanical injuries, the use of alcohol, tobacco, etc.

TUMORS OF THE BREAST

In this same former publication (*loc. cit.*) I had pointed out that the original breast lesion in eight of the twelve breast cancers developed along with an existing endocervicitis. The other four cases traced their cancers to accidents of nursing. A more careful study of the history of the last four cases has now revealed the fact that they were also suffering from an endocervicitis at the time of the development of the caked breasts. In none of these cases did cancer develop, however, until they had first suffered from abscessed teeth and the general cachexia resulting from them.

Fifty-four more tumors of the breast have now been added to this series of breast tumors. Among these there were 28 cases of carcinoma of the breast, representing only cases which I was able to see in the office or in the clinic and upon which I was able to make a most careful physical examination and from which I was able to obtain

a complete history. The remaining 26 patients had benign lesions in their breasts.

Out of the 26 cases of benign breast tumors now carefully studied, there were two cases with fibrous breasts, the lesion being bilateral in each instance. They occurred in unmarried women of the type who do not marry. These patients were also suffering from a degeneration of the uterus, with small fibroids. The breast in one of these cases was removed, and was found to be composed of a solid mass of hyaline connective tissue in which only a few of the larger ducts had persisted. Near the nipple of this breast was a large area of calcification (quite typical bone formation), the whole resembling very much the calcified thyroids seen in certain types of goiter. The uterus in the other case was removed on account of a bleeding submucous fibroid and a vaginitis and cervicitis. The operation was performed in February, 1930. The breasts had softened very decidedly by the following September, but they have not healed completely.

There were two cases of multiple lumpy breasts in unmarried women 32 and 35 years old, respectively, both of which had shown marked symptoms of undeveloped thyroids, dysmenorrhea, and some vaginal discharge. One of these patients developed a small goiter three years ago and is now showing more definite symptoms of hypothyroidism.

There was a case of diffuse adenomatous degeneration of both breasts and one case of intracanalicular adenofibroma, with one small cystic adenofibroma. In this latter case both lesions existed in one breast. The woman is a large, moderately fat, thyroid type, with some evidence of a previously existing specific endocervicitis. The former case of diffuse adenomatous change was in the breasts of an unmarried woman, aged 44, suffering from a very definite endocervicitis, with excessive menstruation at irregular intervals. Whether or not a

specific infection existed in the uterus of this patient could not be determined. Before the breasts were removed she had suffered little from the uterine condition, but had run a fever for three years which she had finally associated with the breasts. The uterine lesion then became quite active a year after the removal of both breasts.

The remaining benign lesions, 20 in number, occurred in married women. Six of them had never had children; eight had had one child each; two had had one child each, and later one or more miscarriages; four had had two children each, with or without later miscarriages. Careful physical examination of these women showed practically all of them to be healthy persons except for chronic endocervicitis. In each instance the patient gave a history of the uterine lesion having existed for several months, and often for several years, before the appearance of the tumor in the breast. Six of these cases have now been operated on, each one of them showing the same type of lesion, classed as chronic cystic mastitis.

This latter group of women, quite different from the other cases mentioned above, gave normal menstrual histories. Their trouble had come on after the development of an endocervicitis and in most instances it was possible to prove definitely that the uterine and cervical lesions were of specific origin.

CANCER OF THE BREAST

Most of the breast cancers developed in women who had carried tumors in their breasts for several months or years before the onset of their serious trouble. Nine of those women were between the ages of 35 and 40; six were between the ages of 40 and 50; eight were between 50 and 60; five were between 63 and 70. All gave very definite histories of chronic endocervicitis and in most instances this was evidently of specific origin. In four of the cases only did we

believe that endocervicitis might have developed otherwise, these having suffered for many years from chronic appendicitis and other intestinal lesions, which may have accounted for the uterine infection. Besides these particular lesions, all these patients, except one, were suffering from dead and abscessed teeth; this latter case had degenerate tonsils and chronic cholecystitis. There were degenerate tonsils in six of the other cases, and in two, there were dead and abscessed teeth and an active chronic appendicitis and cholecystitis. In a third case there was one dead tooth, an active subacute and chronic appendix, and a gall bladder with stones.

While the uterine lesion seemed to be important in the development of the precancerous lesion of the breast, there was no evidence to show that it played any important rôle in the development of the cachexia and the cancer itself. In more than half of the cancer cases the breast lesion had been carried for from ten to thirty-nine years. It was only with the development of the deteriorating lesion, a lesion capable of causing marked cachexia, that the malignancy developed.

EFFECT OF THE REMOVAL OF THE CERVIX AND UTERUS OR UTERUS ALONE ON THE PROGRESS OF BENIGN TUMORS OF THE BREAST

The one case with chronic fibrous breasts from which the uterus, tubes, and cervix were removed has been described above. A distinct softening of the breast is now noted after eight months. This patient had a persisting vaginitis, which is also improving at this time.

Another patient, coming to the clinic in January, 1930, was suffering from multiple ill-defined lumps in both breasts and an endocervicitis. She had had six children, all of whom are living and well, the oldest, 26, the youngest, 12. There was also



Fig. 1-A. Photograph showing a cancer in the left breast of a woman suffering from abscessed teeth and who had suffered for many years from chronic endocervicitis.

a small fibroid in the wall of the uterus and one tooth with a root canal filling, but no abscesses. The uterus and dead tooth were removed. The breasts have now healed after eight months, only one very indefinite area of induration persisting.

Another patient tells me that she had carried lumps in her breasts for years, and that she had suffered also during that time from severe pelvic distress. She says that operative relief for the pelvic lesion led to the disappearance of the lumps in the breasts after four months.

A woman, aged 32, with an active endocervicitis and a definite lump in her right breast, became well after ten days of medical treatment for the endocervicitis. This lump recurred, to disappear again with more medical treatment of the uterus.

RESULTS OF REMOVING TEETH AND OTHER LESIONS ON THE TREATMENT OF CANCERS OF THE BREAST

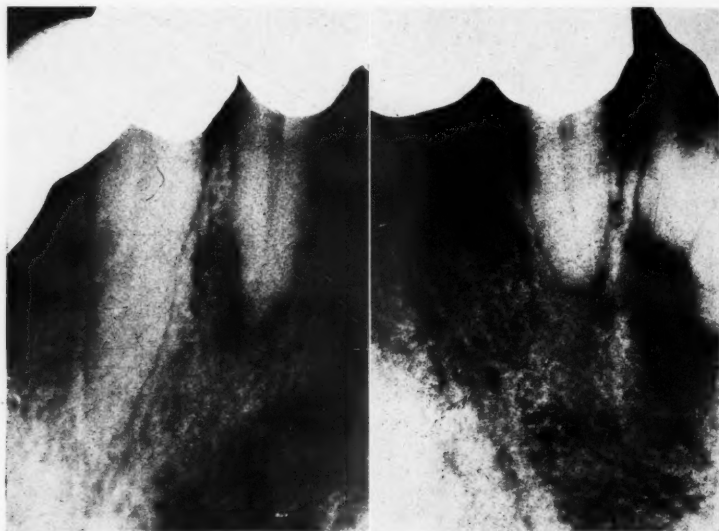
All patients with cancer of the breast coming for treatment have been studied

carefully for degenerate lesions, and, when possible, these lesions have been treated carefully before the cancer was considered. Our results have been exceedingly good.

Two patients with carcinoma had had their diseased teeth removed at the time of

very well. Her blood count is normal. The cancer itself is apparently having no particular effect on her general nutrition.

Two cases of early carcinoma of the breast developing in typical areas of chronic cystic mastitis were examined in May and



Figs. 1-B and 1-C. Negative prints of X-ray films of a few of the abscessed teeth in the case shown in Figure 1-A.

the development of the cancer. One was a typical case of Paget's disease in a woman of 59, who had had eczema about the nipple for two years. I removed the breast and found a cancer of the duct, but no extension to the lymph glands. The other patient had developed a cancer in her left breast thirteen years previously. Her teeth had all degenerated just previous to the development of the cancer. She had them removed just after the cancer developed. She had also had a partial treatment of the breast with X-rays, stopping because of roentgen sickness. During the thirteen years the cancer has slowly distorted the breast, but there had been no extension to the axilla, the lungs, or other parts. She has refused to have the breast removed because she feels

September, 1928, respectively. The first patient, aged 44, had noticed a lump in her right breast one year previously. During the following winter she began to suffer from fatigue. Recently the lump has grown and pain and swelling have developed in her knees. She had two dead teeth with apical abscesses, an emphysema of the lungs with chronic bronchitis, and arthritis of both knees. She suffered severely from uterine disturbances when her only child, now aged 12, was born. However, the uterine lesion healed apparently a few years ago. The two dead teeth were extracted and later the breast, together with the glands beneath the pectoralis major, were removed, the muscles being left intact. This woman gained 20 pounds during the next year and her anemia

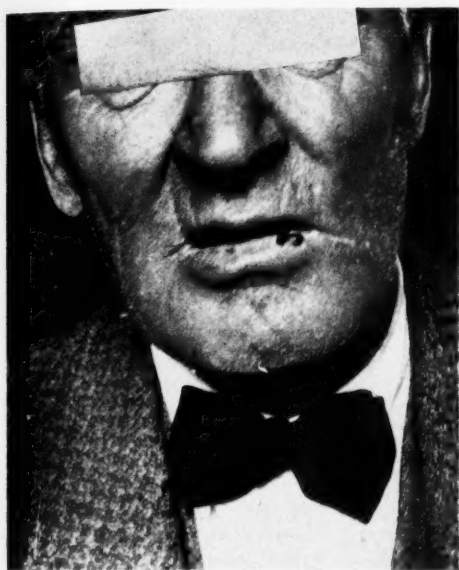


Fig. 2-A. Multiple carcinomas of the lower lip.

disappeared, but the arthritis in her knees and the emphysema have remained about the same. There has been no evidence of any recurrence of the cancer, three years and three months after treatment.

The other woman, aged 69, had noted a decline two years previously while making a trip around the world. In India she had several teeth removed. In May, 1928, she had a bridge constructed on two dead teeth which showed no abscesses. Immediately after this she became anemic and her right breast began to cause her trouble. When she came for examination in September, 1928, she had an area of well defined chronic mastitis in the right breast. She had suffered caking of this breast while nursing her first baby, thirty-nine years previously. Another child had been born four years after the first. She had suffered from vaginal discharge from the time of the birth of her first child until her menopause. There had been no other pregnancies.

This patient refused to have her teeth re-



Fig. 2-B. Same case as shown in Figure 2-A. Dotted line indicates the line of incision for the removal of two of the carcinomas.

moved and did not return again until January, 1929, at which time she had more definite signs of cancer of the breast. A radical operation was performed at once and an area of chronic cystic mastitis with cancerous degeneration was found in the breast, but no glands were involved. In February, 1929, she developed arthritis in five joints. Her teeth were given X-ray examination at

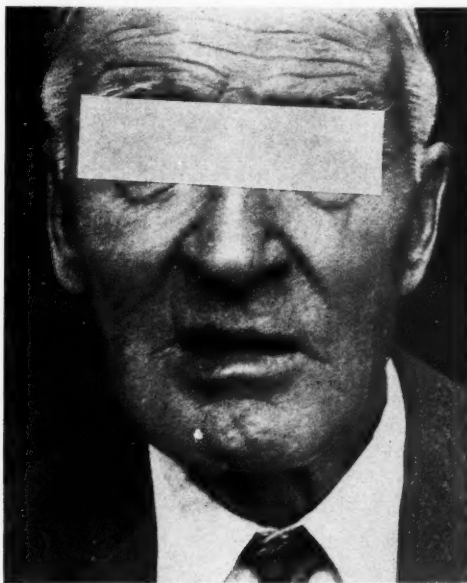


Fig. 2-C. Photograph of case shown in Figures 2-A and 2-B, taken four months later. The other carcinomas disappeared spontaneously after removal of the abscessed teeth.

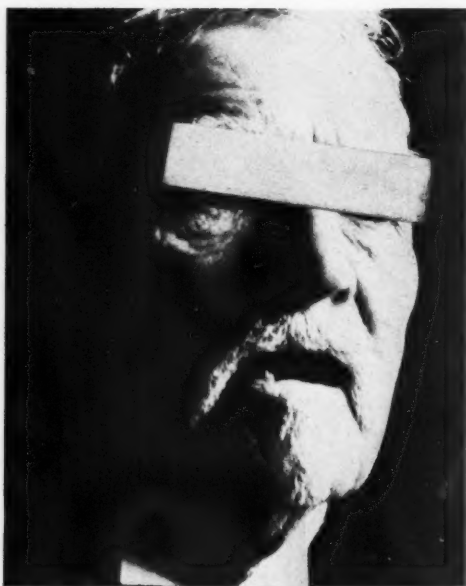


Fig. 3. Photograph of rodent ulcer on the lower right eyelid. This ulcer disappeared spontaneously in three weeks after the removal of one dead and abscessed tooth.

that time. All of them showed signs of degeneration. There were many deep pyorrheal pockets, and there were apical abscesses on the two teeth supporting the bridge. These latter two were removed, but she refused treatment of the other teeth. Her rheumatism became better but her anemia persisted. She returned again in January, 1930, with twelve recurrent nodules in the skin of the breast. This area of skin was removed and radon seeds were planted in the tissue between the ribs; however, four more nodules appeared within the next two weeks in other parts of the outlying skin. These were removed and the remaining teeth were extracted. Later, the denuded areas were covered with Thiersch grafts, the wounds healing well. Her letter, dated September 1, 1931, states that her anemia has disappeared and that she has not felt so well in years.

The results have been excellent in all the

other cases in which the degenerate lesions have been treated carefully. Two cases with dead and abscessed teeth, together with subacute appendicitis and gall-bladder disease, have run a rapid course downwards in spite of all attempts to treat the breast lesion. It was not possible to do abdominal operations in these cases.

König had looked upon chronic cystic mastitis as an inflammatory lesion. This view prevailed until the earlier writings of Schimmelbusch, who taught that it was not an inflammation but a tumor. Since that time more and more authors have taken this latter view. In 1919, Pribram (10) pointed out a possible relation of this lesion to abnormalities in the secretions from the sex glands. Later, Küchens (11), in a careful histologic study of benign lesions of the breast, took a similar view, and more recently Taylor (12), in a review of 271 cases of breast tumors from the General Memorial Hospital, has also come to the same conclusion.

While many authors do not believe that all breast cancers arise in pre-existing breast lesions, in a study of over 180 cases in St. Louis, I (13) was able to find evidence of a previous chronic mastitis in every case. Besides these cases of carcinoma, many benign lesions were also studied. It was in this investigation that I was impressed by the similarity between these breast lesions and goiters, as well as the lesions produced by coal tar and X-rays (14). It has already been shown that cancers of the thyroid arise probably always in pre-existing adenomas. By experiments we were able to show that hyperstimulation may act to remove the fat-soluble vitamins from a tissue as does coal tar.

A careful study of benign and malignant lesions of the breast has shown that uterine lesions exist in every case. This uterine lesion is not, however, responsible for the cancerous process, apparently leading only

to induction of the formation of benign lesions. Cancer has developed in these cases only when they have suffered from cachexia related to other causes, and it is interesting that teeth have been apparently

Radium seems to act differently in this regard. When we have not been allowed to have the teeth removed and have used radium properly for the removal of the cancer, there has been no recurrence at the site



Fig. 4-A. Basal-cell carcinoma which developed at the site of a boil on the right side of the neck.

the most frequent cause of this later deterioration (Figs. 1-A, 1-B, 1-C).

STUDIES OF CANCERS OF THE SKIN OF THE FACE AND THE NECK AND THE LOWER LIP

This relation of abscesses of the teeth to the development of cancer is seen also in the study of cancers of the skin and lip. Of the 102 cases of cancers of the skin of the face, body, neck, and lips, abscessed teeth were present in every case. Chronic polypoid changes in the antrum were also present in two cases and chronic degenerate tonsils were present also in the remaining six cases. In all of those instances in which we have removed the offending lesions in the teeth, tonsils, or elsewhere, a simple surgical removal of the cancer has led to quick healing, often without visible scars. In other cases in which the patients have refused to have the teeth, tonsils, or other lesion removed, either hypertrophic scars or recurrences have been the result of these simple surgical procedures.



Fig. 4-B. Photograph of the same patient shown in Figure 4-A, taken four weeks later. The ulcer disappeared spontaneously, leaving only a small soft tumor to mark its site.

of the lesion, but in most of these cases cancers have appeared in other parts of the skin within a few weeks or months.

In most of these cases of cancer of the skin, senile keratoses have preceded the development of the cancers. Multiple boils have been the precursors in other cases, cancer developing finally in one of the boils. While most of these cancers have been basal-cell in type, a few typical prickle-cell cancers have been seen and they have responded as readily to this form of treatment as the rodent ulcers.

Not only the cancers are easily cured after removal of the degenerate teeth or tonsils, but the keratoses also have disappeared often. Removal of teeth, together with the administration of a small amount of cod liver oil, has caused the complete dis-

appearance of keratoses in a number of cases.

REMOVAL OF TEETH OR TONSILS WITHOUT TREATMENT OF THE CANCERS

Having obtained these interesting results we tried, then, to see what the effect of the

A man, aged 59, with recurrent boils on his neck, an infected and degenerate wisdom tooth, and other teeth with deep pyorrheal pockets, came for examination in September, a cancer having developed in one of the boils (Fig. 4). The teeth were removed. The ulcer on neck has healed; only a small soft superficial tumor in the skin marks

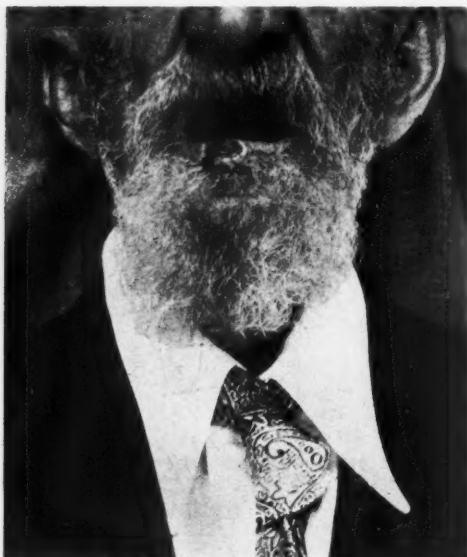


Fig. 5-A. Photograph showing a rodent ulcer on the lower lip of a man 83 years old, with degenerate tonsils and bilateral peritonsillar abscesses. A large shallow ulcer on his upper lip does not show.

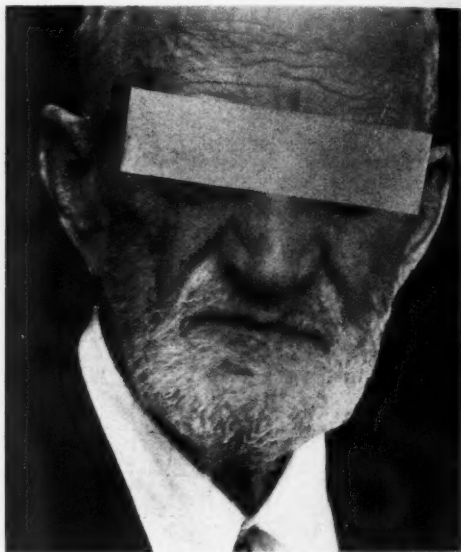


Fig. 5-B. Photograph of the same man shown in Figure 5-A, four months later and after the tonsils and the ulcer on the lower lip had been removed. The ulcer on the upper lip disappeared spontaneously.

removal of the teeth or the tonsils might have on some of these cancers. A man with four superficial prickle-cell cancers of the lower lip and three remaining dead and abscessed teeth was treated by removing one of the cancers and the three teeth. The other cancers have disappeared without treatment (Figs. 2-A, 2-B, 2-C).

One man, aged 83, with a small early rodent ulcer on the lower eyelid (Fig. 3) and three remaining teeth, was treated by removing one abscessed tooth. Two of the three teeth were worn, but alive; the other was abscessed. In three weeks the eyelid had healed.

the site of the cancer after four weeks (Figs. 4-A, 4-B).

In another case with an associated sinusitis, the growth of the rodent ulcer ceased with the removal of the teeth but the ulcer had not healed after two years. It was removed later, with a good result. Several root fragments have been found recently in the jaw of this woman.

In another case, a man of 82 years, there were ulcers on both the upper and lower lips (Fig. 5-A). Degenerate tonsils, with discharging peritonsillar abscesses, were also present. The tonsils and the lesion on the

lower lip were removed. The lesion on the lower lip was found to be a degenerating rodent ulcer. The tonsils were found to be composed largely of dead hyaline material. The scar on the lower lip is scarcely visible, and the upper lip ulcer healed completely in six weeks' time without treatment (Fig. 5-B).

SUMMARY AND DISCUSSION

From the study of benign tumors and cancers of the breast we have come to believe that these lesions are secondary always to degeneration of the sex glands. These primary lesions in the sex glands may be congenital or acquired. In women with abnormal development of their sex glands the breasts may degenerate completely: a fibrous breast, later undergoing hyaline degeneration and calcification may be the result. Taylor (*loc. cit.*), in his studies, notes this relation of fibrous breasts to degenerative changes in the sex glands and secondary sexual characters. In apparently normal women, acquired disease of the sex organs may bring about changes in the breasts. The change in the breasts in these cases is generally a chronic cystic mastitis. Gonorrhea was probably at the root of the trouble in the uterus in most of our cases with apparently previously normal sex glands.

The histology of the precancerous breast lesions is not different from that seen in the thyroid gland, classed under the heading of goiters. These lesions are probably the result of hormonal imbalances. The breasts of women suffer from stimulation and regression during each menstrual cycle. The picture which one sees in these breasts is, according to my experiments, what one might expect from over-stimulation or abnormal stimulation in any tissue of the body. Most of these changes can be reproduced readily by coal tar or X-rays.

The changes in the breasts induced by changes in the sex glands are not sufficient,

however, in themselves, to induce a cancerous degeneration. Such breast lesions may exist and progress for years without any material harm to the individual. Cancer will develop in these lesions only when the normal cells of the body without have suffered from a sufficient lowering of their resistance to allow the breast cells to grow.

It has been interesting to note that diseased teeth can cause such a lowering of the resistance of the body to the precancerous area. While it is possible that other organs undergoing the proper type of degeneration can produce similar cachexia or reduction in the resistance of the body cells to the precancerous lesions, the teeth apparently are most often at fault in the cases of cancers of the skin and breasts. Similar cachexias may also be produced by coal tar, other lipid solvents, deficient food, etc. Since we have paid particular attention to the proper treatment of such offending tissues we have had most excellent results in the treatment of breast cancers, cancers of the lower lip, even when the neck is involved, and cancers of the skin (3).

CONCLUSIONS

1. Tumors of the breast have been associated in each instance with uterine lesions.
2. In normal women the most common benign tumor is chronic cystic mastitis. In a large percentage of these cases gonorrhea may have been the immediate offending agent to the sex glands.
3. The lesions produced in the breast in association with the uterine lesions have always been precancerous in nature. Cancer develops in these lesions of the breast only after the organism has suffered from a specific cachexia from other causes.
4. Dead and abscessed teeth have been most frequently associated with these deteriorating states (cachexias) necessary for

the development of the cancers of the breasts.

5. Dead and abscessed teeth have been frequently associated with cancers of the lips and skin and evidence is given to show that they may be the immediate exciting cause of cancers of these tissues.

6. Whether other tissues showing similar degenerative changes may also produce the same effects as the dead teeth has not been determined.

7. Removal of the teeth alone has led to the spontaneous disappearance of cancers of the lips and skin in a few instances.

8. In several cases, senile keratoses have disappeared completely after the removal of abscessed teeth and the use of a good dietary.

Author's Note: Since this work was presented a most careful study of over 100 cases of cancer in organs and tissues other than the skin has shown no relation between these cancers and diseased teeth. Diseased teeth are frequently present in cases of cancer of the tongue (an endodermal structure). Removal of the teeth has had no effect on the progress of the cancers of this organ or cancer in various other internal organs. The teeth (true ectodermal structures) seem to be related only to the development of cancers of the skin and skin appendages (breasts).

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DISCUSSION

DR. E. C. ERNST (St. Louis): We all realize that cancer is, after all, a problem or complication of diseases rather than a single entity. We must be cautious, therefore, not to lean solely in one direction or to consider one phase only of the problem of cancer. This is especially true when the question of treatment, either by X-ray, radium, surgery, or medical methods, is to be given consideration. We must view the problem from a broad, practical, general viewpoint, and above everything else be physician first and last. This is certainly true from the treatment standpoint in early and late cancer. The general physical condition of the patient is important to the extent that the local condition may be influenced thereby, but we must not rely too much on such indirect influences, lest the cancerous lesion develop beyond the reach of local methods of eradication.

I was interested recently to see the trend of studies in this direction throughout various parts of the world, particularly in the work of Dr. Handley. He emphasized the suggestive relationship of tuberculosis to cancer; but he emphasized tuberculosis not as a specific lesion but tuberculosis as a disease, particularly chronic granuloma—the scar, as you know, of a tubercular lesion. Frequently such lesions occur in infancy, but Dr. Handley emphasizes the point that during adult life something happens in the metabolism of the individual and this tubercular lesion springs into carcinoma. On the other hand, of course,

we know that carcinoma is not so infrequent in lupus, but lupus is a tuberculosis of the skin. From all angles, we have to go forward with caution in treating only the general condition of the patient or the infection, without giving due consideration to the necessary other local treatment. We all know that the cancer cell is more or less a living parasite, and we have observed, I am sure, that cancer is intimately associated with chronic infections and also particularly with lymphatic obstructions. Clinical research in this direction is worth while. We must appreciate that chronic inflammatory lesions do play a part; also, the question of lymphatic obstruction is a factor. Lymphatic block, or lymphangitis, as we know, has a relationship to definite diseases—tuberculosis, syphilis, pyogenic infections, and many of the agents which we formerly considered to be the irritants of cancer.

I feel, however, that we must be very cautious not to give too much consideration to any one phase of treatment of cancer. We must continue to be physicians first of all, and continue to give due consideration to the general condition of the patient, but always keep in mind the cure of the cancerous lesion promptly and effectively by the most direct and safe route. Future cancer treatments should continue along rather broad lines, but we must frequently stop, look, and listen.

DR. J. M. MARTIN (Dallas, Texas): The Doctor's paper is extremely radical, to my way of thinking. I am in accord with the practice of dealing thoroughly with every part of the human system, once a cancer has developed. If the teeth are bad, they should be treated or removed. It has been my experience that, once a cancer has developed, anything you may do to effect a cure must have for its object complete destruction of all tissue involved.

DR. GRACE L. HOMMAN (Los Angeles, Calif.): When I was working with Dr. Stacy at the Mayo Clinic, I was much impressed with the oral sepsis of these cancer cases; so much so that I often wondered if there was not some relationship between the disease and oral sepsis. However, when we stop to consider, nearly all these patients are

at an age when oral sepsis is common, because few persons have mouths in good condition after the age of fifty. So I believe, as Dr. Martin has said, that these patients should be put in the very best of condition when they are suffering with such a serious disease as cancer. I have seen in one patient an epithelioma of the face, a cancer of the breast, and a definite epithelioma of the vulva—the patient died of the latter. This case was certainly not one of metastasis, so one wonders as to the etiology when one finds three definite malignancies in one patient.

So far as the endocrine glands are concerned, I find very many of these patients are obese, and recently I found that one of my patients weighing two hundred and forty pounds, with a carcinoma of the fundus, had a basal metabolism of minus 22. I believe that if more work is done along this line, we may find that the endocrines play a very important part in the development of cancer.

DR. BURROWS (closing): I did not use radium or X-rays in most of these cases. To rule out any unknown effect of radium or X-rays, I removed as many of these cancers as possible by surgical methods. I developed a punch method to remove cancers from the face, so that visible scars would not remain to mark the site of the operations; on the body, the ordinary surgical procedures were used. The only patients receiving radium and X-rays were those who either refused to have their focal lesions treated or who had lesions which could not be treated. I have found that a large dose of radium generally prevents a recurrence of the cancer at the site of its removal, where the knife fails. In many of the cases I have used radon seeds. The superficial skin cancers are treated better by applying the radium to the outside.

In those patients whose focal lesions were not treated, no matter what the method used for removing cancers, they have recurred sooner or later either at the previous site or elsewhere.

I feel quite certain that few physicians are paying any attention to lesions other than the cancer in most of their cancer cases. I have

examined many cases of recurrent cancers of the skin and breast and have found practically all of them to be suffering from focal lesions of long standing, the most common being abscessed teeth. Cancers in other organs are rarely associated with this type of focal infection. When such abscessed teeth are present I have often had great difficulty in persuading the patient to have them treated. He and his dentist wish to save the teeth. Again, I have found that abscessed roots are often left after the extraction of the teeth: such roots have been found in about 10 per cent of the cases.

For this reason I have X-ray films made of the gums after extractions, as well as the gums of all patients whose teeth have been extracted at an earlier time.

It should be mentioned here that I have found no evidence to show that removal of the teeth has any effect upon cancers other than those of the skin or skin appendages (breasts, lips, etc.). Removal of the teeth in cancers of the tongue or other internal organs has had no effect. Diseased teeth have been related only to cancers of ectodermal origin in the series of cases I have studied to date.

WHITE HOT PLATINUM IS NEW LIGHT STANDARD

Molten platinum, precious metal, shining with heat, gives the world its best standard of light with which to compare the brightness of lamps or stars. At the Bureau of Standards, Washington, D. C., four physicists have produced this new light standard. Using an idea suggested by Dr. G. K. Burgess, Director of the Bureau of Standards, and his associate, the late Dr. C. W. Waidner, the platinum light standard was tested experimentally by Dr. H. T. Wensel, William F. Roeser, L. E. Barbrow, and F. R. Caldwell of the Bureau's staff. A flame of standard type, burning fuel at a

known rate, has been used in the past as a standard, but its brilliance varies with changes in atmospheric conditions.

Platinum, pure to one part in 30,000, is fused electrically in crucibles of thorium oxide.

Comparisons with its light are made when the platinum is melting or freezing. Its temperature then is about 3,200° Fahrenheit. Light produced under these circumstances is remarkably constant. Reproducibility is of first importance for a standard, and the values of the platinum standard are repeatable to a tenth of 1 per cent. The precise value of the new light standard is 58.84 international foot candles per square centimeter.—*Science Service*.

FIRST ROENTGEN EVIDENCES

By OTTO GLASSER, Ph.D., Cleveland Clinic, CLEVELAND, OHIO

IN an excellent treatise, Dr. Sanford Withers, of Denver, recently described in detail in this Journal "The Story of the First Roentgen Evidence."

The first days after the discovery of the new science of roentgenology comprise a chapter of romantic interest. The introduction of X-ray plates at the court trial in Denver, described by Dr. Withers, has also been mentioned recently from information gathered from the "Electrical Engineer," New York (Dec. 23, 1896, XXII, 655) and "Electrical World" (December 19, 1896, XXVIII, 759), in my book just published by Springer, Berlin, on "W. C. Roentgen and the History of the Roentgen Rays," together with similar incidents which antedated the Denver trial.

A case which was described in detail on March 20, 1896, in the "British Journal of Photography" (XLIII, 179) and in June in the "British Medical Journal" was commented upon in American journals as early as April, 1896 ("Literary Digest," April 11, 1896, XII, 707, and "Electrical Engineer," New York, June 10, 1896, XXI, 622). The "Literary Digest" wrote, for instance, under the title: "The New Photography in Court":

"An interesting and novel case, in which the 'X-rays' practically decided the point, was tried by Mr. Justice Hawkins and a special jury at Nottingham the other day, says 'The Hospital,' London. Miss Ffolliott, a burlesque and comedy actress, while carrying out an engagement at a Nottingham theater early in September last, was the subject of an accident. After the first act, having to go and change her dress, she fell on the staircase leading to the dressing-room and injured her foot. Miss Ffolliott remained in bed for nearly a month, and at the end of that time was still unable to re-

sume her vocation. Then, by the advice of Dr. Frankish, she was sent to University College Hospital, where both her feet were photographed by the 'X-rays.' The negatives taken were shown in court, and the difference between the two was convincingly demonstrated to the judge and jury. There was a definite displacement of the cuboid bone of the left foot, which showed at once both the nature and the measure of the injury. No further argument on the point was needed on either side, and the only defense, therefore, was a charge of contributory carelessness against Miss Ffolliott. Those medical men who are accustomed to dealing with 'accident claims'—and such claims are now very numerous—will perceive how great a service the new photography may render to truth and right in difficult and doubtful cases. If the whole osseous system, including the spine, can be portrayed distinctly on the negative, much shameful perjury on the part of a certain class of claimants, and many discreditable contradictions among medical experts, will be avoided. The case is a distinct triumph for science, and shows how plain fact is now furnished with a novel and successful means of vindicating itself with unerring certainty against opponents of every class."

The presentation of the new "wonder pictures" before a solemn court had, of course, various effects. Not everybody was to be convinced immediately of the great value of such pictures for court procedures, and "some amusing remarks were made," said the "Journal of Photography": "On the defendant's counsel telling one of the witnesses that he ought to have scientific evidence as to the value of the rays, Mr. Justice Hawkins remarked, 'You might send a man to the lunatic asylum, you know, by photographing his head.' One of the barristers,

looking at the photographs, asked, 'Is this the Trilby?' etc. Evidently the 'New Photography' was treated with a certain degree of levity on its first appearance as a witness, by gentlemen of the long robe."

Another English case, in which X-ray plates were used as evidence, was described on July 17, 1896, in the "British Journal of Photography" (XLIII, 461), under the title "A County Court Judge and the Roentgen Rays."

"At the Liverpool County Court on Monday, during the hearing of an action under the Employers' Liability Act, in which a dock laborer claimed £150 damages for personal injuries, the plaintiff's counsel produced two photographs of the injured arm, taken by means of the roentgen rays. He proposed to use these photographs as evidence. The defendant's counsel objected, stating that he had no reason to believe that Dr. Buchanan, of the University College, by whom the photographs had been taken, was competent to produce reliable radiographs by the new process. Judge Shand replied that, from all he had read concerning the process, he believed that he himself should be able to take photographs by this method, providing he had the necessary apparatus. Dr. Buchanan agreed, stating that the process was perfectly simple, and could be carried out by anyone. Judge Shand felt compelled to admit the authenticity of the photographs, but stated that the question as to their value must be discussed by the defendant's counsel and the jury. When the photographs were produced, they showed clearly the injury which had been done to the bone of the plaintiff's arm and the jury awarded the plaintiff £60 damages."

The New York physician, William J. Morton, who was an enthusiastic X-ray pioneer, repeatedly called attention to the importance of X-ray pictures for expert testimony in his book, "The X-ray," which was published by the American Technical Book Co. on September 1, 1896. He states: "A

very important application of the X-ray will be in connection with expert testimony in the court. Court records contain numerous cases in which the X-ray would have been of great service. Already it has been used for this purpose . . . Figure 90 shows a picture of the knees of a person which is likely to find its way into court. The patient was thrown down with violence in a trolley-car accident more than a year ago, and has suffered more or less ever since. An exposure was first made of the injured knee only and afforded no positive evidence of the seat or degree of the injury. By resorting to the comparative method, a picture of both knees was obtained (Fig. 90) which showed that the upper portion of the large bone of the leg below the knee was nearly three-quarters of an inch wider in the injured knee than in the normal one. This was doubtless due to fracture and subsequent growth of bone. Such a picture is very convincing and would be sure to have great weight with a jury."

"*Note:* The original X-ray negative of Figure 90 is now a court record and it is impossible to obtain possession of the same to make a half-tone reproduction until the case is settled. The picture will be reproduced in future editions of this work as soon as the original negative can be obtained."

At about the same time the "Journal of the American Medical Association" (July 18, 1896, XXVII, 168) reported the use of X-ray plates in a trial in the French city of Nancy, as follows: "We note that at the trial of an action for damages at Nancy, in France, the surgeon who had charge of the injured plaintiff was accused of having caused the damage by mistaking a dislocation for a fracture. The accusation was sustained by producing in court a Roentgen photograph which showed clearly the bones in the dislocated position without a fracture." The physician lost the suit.

An interesting use of X-ray pictures in a case of attempted murder was also described in the English "Journal of Photography,"

toward the end of the year 1896 ("British Journal of Photography," Oct 23, 1896, XLIII, 683).

"Henry Goodwin was again brought up last week at the Salford Police Court, and charged before Mr. R. Hankinson and Mr. Alderman Jenkins with burglary and attempting to murder Mr. Israel Rosenblum, merchant, Northumberland Street, Higher Broughton. Prisoner was remanded for another week on the application of Chief Detective Inspector Lyogue, who said there was now a likelihood of Mr. Rosenblum's recovery, but he would not be in a fit state to attend court for two or three weeks. In the course of an interview, Dr. Walmsley, the medical attendant of Mr. Rosenblum, stated that his patient had been radiographed by Mr. Chadwick, of St. Mary's Street, and, as the result of the process, the bullet was discovered in the chest. An operation with a view to its extraction will be made in the course of a few days."

The alacrity with which the medical and the judicial professions quickly took up the new discovery of Roentgen and made use of it as evidence in court trials is remarkable. It is little to be wondered at, then, that persons less concerned with the real truth

looked into this use of the X-ray for more or less fraudulent purposes. On August 8, 1896, the "London Standard" carried the following advertisement: "The New Photography.—Owing to the success Mr. Henry Slater has personally achieved with the New Photography, he is prepared to introduce same in divorce matters free of charge. Offices No. 1. Basinghall Street, City."

Just how the roentgen rays could be used for the purpose of clearing up divorce matters was not explained, but a theory about the matter was produced by the editor of the "Electrical Engineer," New York (XXII, 253), who wrote on September 9, 1896:

"Mr. Slater, as a detective, is evidently up to date. We presume he uses the X-ray to discover the skeleton which every closet is said to contain. Ability to do the detective act without squinting through a keyhole is regarded, evidently, as one of the recommendations of the rays, which themselves prefer darkness rather than light."

It is probable that the foregoing list of first roentgen evidences could be increased. These evidences form an important part of the general romantic and enthusiastic reception of the discovery made by Wilhelm Conrad Roentgen.

ULTRA-VIOLET IRRADIATION IN THE TREATMENT OF FRACTURES

By PROF. M. PONZIO, Director of the Mauriziano Radiological Institute of the Hospital Humbert I, TURIN, ITALY

Translation by E. T. LEDDY, M.D., Rochester, Minnesota

THE numerous experiments carried out during the past few years have served to clarify many problems in human metabolism, especially those of the pathology of callus formation. Many causes are known for the failure of normal healing of fractures: among them are faulty juxtaposition of the fragments, due to imperfect reduction of the fracture or interposition of soft parts. There are other causes due to changes in organic equilibrium which may impede or retard osseous consolidation in cases which, in themselves, seem favorable for healing. When these occur, it is possible to establish the cause of non-union in many cases, and at times to predict it, especially when an infectious process can be suspected, either a local or a general one, and particularly one of a tuberculous or syphilitic nature; but in others the cause is more complex, and depends on trophic changes concerning which we have only an imperfect knowledge. At present, much attention is being directed to those cases in whom the absence or retardation of callus has no apparent cause, or is associated with changes in those internal secretions which govern calcium metabolism, or with vitamin deficiencies, or with osteomalacia, or other affections more rare but of no less importance.

The experiments of Israel, Hintze, and Katzenstein have shown conclusively the important rôle which the internal secretions may play in calcium metabolism in fractures, in that they showed clinically and experimentally that an altered ovarian function produced marked changes in the consolidation of osseous callus. The function of the parathyroids has been shown to be

very important in processes of osseous repair; defects in the bone may result. Oga-wa, Huepper and others have shown that in parathyroidectomized animals the consolidation of the callus is greatly delayed and may in some cases not take place at all.

Analogously, the condition of vitamin balance is of great importance in the behavior of callus. Israel and Fränkel have shown experimentally that a diet deficient in Vitamin C may produce a marked delay in ossification of callus, whereas the administration of this vitamin in excess was of great value in consolidating a callus (Schilowrew). The use of antirachitic Vitamin D may have a favorable effect, as was shown by Ferrero in rabbits treated with irradiated stearin, which contains a high percentage of antirachitic vitamin. In this field, however, it is not possible to draw definite conclusions, as many of the experiments are incomplete or insufficient to establish finally in what forms and to what degree antirachitic vitamin may be effective. And this is easily understood, as in many cases we do not know the mechanism underlying many of these bone dystrophies, nor do we know exactly the nature and the properties of the vitamins. Nevertheless, modern practice advises in cases of slow callus formation the use of calcium preparations of various composition, with the idea of bringing into the body substances which will re-establish such an endocrine balance as to give to the tissues the greatest aid in the processes of osseous repair.

Recent experiments of Schultzer and M. Clevdon on phosphorus and calcium metabolism in animals on a fixed diet, but irradiated with ultra-violet or given irradiated

oils, have shown that the initial figure for calcium was doubled after treatment; similarly, the experiments of Lesne, Turpin, and Zirive on white mice irradiated with ultra-violet showed that the level of organic calcium was raised markedly. Springer and Taradieu have confirmed these experiments and conclude that ultra-violet radiations have a eutrophic action manifest all over the body, but especially in their ability to raise the total calcium level. This action, according to Mouvriquand, Bernheim, and Teobalt, is present more or less throughout the whole range of the ultra-violet radiations.

The investigations of Huldshinsky and Sachs, Worringer and Zehnter were carried out on blood calcium in spasmophilic patients who had ultra-violet treatment. They showed that, after this actinotherapy, there was a rapid increase of calcium in the blood, so that it reached normal in a short time and remained at a normal value. Similar changes were noted by Ferri in the spinal fluid of spasmophilic patients after ultra-violet treatment. Actinotherapy is, therefore, of great importance in re-establishing the calcium balance in cases of spasmophilia.

Detailed experimental observations have shown that ultra-violet produces an immediate calcemia which is due, according to Kraus and Zoudek, to a rise of the hydrogen ion concentration of the blood. This calcemic state, according to Atzler and Gunther-Lehman, is produced either by a direct action of the ultra-violet or by an indirect effect by vasodilatation and greater circulatory activity. This hyperemic stage is followed by processes of fixation of calcium and of phosphorus, probably because of the activation by ultra-violet rays of the cholesterol in the blood; and this is, according to Windhaus, by transformation of it into Vitamin D.

Now, if the level of calcium in the blood is favorable after ultra-violet irradiation, it is logical to suppose that even the completed process of calcium fixation should be more

lively and active, and this is of especial importance in cases in which there are notable changes in calcium balance. Such considerations have led many investigators to try to combine the administration of calcium and of ultra-violet in cases having severe osseous decalcification such as occurs in osteomalacia, tuberculous processes, etc. The observations of Rosen, of Weil and Guillaumin, of Worringer, of Rothmann and others on the metabolism of calcium and its fixation by means of ultra-violet in cases with tuberculous osseous lesions, and especially the recent observations of Clavelin and Sicard on various osteo-articular affections, have shown that this theoretical conception may have a favorable application in a practical way, and the results obtained seem to recommend the method most highly.

The experimental and clinical results obtained in this field have led us to try the method on surgical cases of pathologic fracture in which the retardation in callus formation was specially well marked. To this end some investigations, both clinical and experimental, were started in the Istituto Radiologico dell'Ospedale Mauriziano, to find out to what extent the actinocalcic method might influence favorably the consolidation of pathologic fractures.

Dr. Conte, assistant at the Institute, did some experiments on rabbits in which the diaphysis of a long bone, especially the femur, was fractured by puncture in such a way that the fractures resulting were quite similar in all the animals used in the experiment. Some of these animals were taken for controls; others received intravenous injections of calcium chloride; others received ultra-violet irradiation, and still others had a combination of ultra-violet and calcium. The injections and the radiation were carried out on alternate days after the fifth day from the beginning of the experiment until the thirty-fifth day, at which time the animals were killed. At that time some of the animals had, therefore, received fifteen in-

travenous injections of calcium, others fifteen ultra-violet irradiations, and others had had fifteen applications of ultra-violet and fifteen intravenous injections. The ultra-violet treatment of the second and third groups was done simultaneously with the use of a Gallois lamp at a distance of 60 centimeters for twenty minutes daily, the animals being fastened supine with the fractured bone facing the lamp.

The intravenous injections were done into the marginal vein of the ear, which had previously been made hyperemic. The strength of the calcium chloride solution was increased progressively from 1.5 per cent to 2.5 per cent; 5 c.c. were injected at a time, a total of ten injections being given. It was not thought expedient to use solutions of greater concentration (5-10 per cent) as were used by some German experimenters. The irradiation of the animals was carried out immediately after the injections.

During the period of observation the behavior of the callus was checked up by radiographs after ten, twenty, thirty, and thirty-five days, respectively, during which time the callus had definitely consolidated.

Examination of the sets of radiographs showed, first of all, that there was no difference in the callus in the control animals compared with those receiving only the intravenous injections of calcium or only the ultra-violet treatment, but there was a definite difference in the animals which had received combined intravenous and ultra-violet treatment. The difference was to be seen at various stages of the experiment, but was especially well marked in the terminal period (thirtieth to thirty-fifth day), when the activation of the process of repair was most manifest.

Supplementing the radiologic and clinical examinations, determinations of the percentage value of calcium in the callus were made at the time the animals were killed. The difference between the weight of the dry bone and that obtained after incinera-

tion showed clearly a greater quantity of inorganic calcium in the bones of the animals which had the combined treatment. This difference averaged 4 per cent. The values have, however, only a relative worth as, in the experiment, tissues in the process of evolution and a long way from being stable were considered, but still they are a sufficient index of local calcium fixation. From the amount of the salt injected (1.6 grams), it was calculated that at most 20 centigrams were fixed in the fracture, the rest being eliminated, or stored elsewhere in the body.

These experimental observations led us to start, on our hospital service, a series of treatments with combined calcium and ultra-violet, in which we selected a series of fractures in which callus formation was retarded or defective. We carried out the first experiments by giving the calcium orally, using mostly chloride of calcium, tricalcine, and other calcium preparations, giving them in variable quantities two hours before irradiation. In a few cases, the calcium chloride was given by rectum (200 c.c. of a 5 per cent solution). The irradiations were made daily, limiting them to the injured member at the site of the fracture. A second series of patients were irradiated after they received a hypodermic injection of calcium a quarter-hour before ultra-violet irradiation. Only a few cases were given intravenous injections of calcium chloride in 1.5 per cent solution, because many patients were reluctant to take such a treatment continuously.

The cases treated confirmed the clinical and radiologic results of the experiments on animals. There was a marked activation of the process of repair during the course of the calcico-actinic treatment in those cases of retarded callus formation, not only in those that had a definite calcium deficiency, but also in those in which deficient calcification seemed to be due to some general dystrophic process. Combined treatment was more efficacious than the simple administra-

tion of calcium salts or of ophoterapeutic preparations. One may mention here the experience of Blum, who showed changes in the acid-barium balance in the blood produced by the introduction of calcium salts into the circulation, changes which favored decalcification and which tended to produce the formation of bony callus. This change did not occur in Conte's cases with combined treatment, which shows that, with this technic, the fixation of calcium is rendered more active.

The administration of calcium salts hypodermically has been found to be the best of all methods and easy to carry out in definite dosage. We generally used calcium chloride 5 per cent in 5 c.c. solution; in a few cases we used serum and calcium mixed (3-4 c.c.).

Measurements of calcium absorption showed there was a rapid rise in a short time after injection, the rise lasting for a varying time up to from 3 to 4 hours. This is the best period in which to do the treatment with ultra-violet. In a few cases in which the calcium was introduced into the body directly by vein, according to the suggestion of Clavelin and Sicard, Rothmann, Weil and others, we injected 100 to 200 c.c. of 1.25 per cent solution without the patient's noting any disturbance except a tran-

sient malaise and an intense taste of lime in the saliva. The treatment with ultra-violet was given immediately after the injection.

Our observations, although few in number and rather incomplete, since in some cases we were unable to obtain a good follow-up, still have much value in showing to what extent the use of calcico-actinic therapy may help, in addition to the other methods in the treatment of fractures in those cases in which there is retardation of callus formation and lack of consolidation of it.

Further experiments are in progress to find out at what period ultra-violet irradiation is useful in delayed healing of fractures, especially in open infected fractures, and to find out whether, in these cases, the combined treatment may offer any advantages. Another group of cases is being investigated to learn if the method of combining calcium and actinotherapy is to be preferred in cases of slow callus formation to roentgenotherapy with small doses, a technic reported by Cluzet and Dubreuil, Fränkel, Köhler, Kriwski, Salvetti, Turco and others.

In all cases the study of radiotherapy, either by roentgen or ultra-violet rays, in callus formation, assumes great importance in traumatology, and deserves most careful investigation.

RADIUM AND X-RAY TREATMENT OF MYOPATHIC AND THROMBOPENIC MENORRHAGIA

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DURING a period of ten years we have admitted to our tumor clinic 1,993 cases in the gynecological service. Included in these are 77 cases of bleeding from the uterus in patients varying in age from 17 to 70 years. Many of these patients gave a history of prolonged and varied medical treatment. Physical examination revealed no demonstrable pathology, such as newgrowth, incomplete abortion, polyps, malignancies, and so forth, but they were considered as of particular interest because they were regarded as cases of myopathic hemorrhage (72 cases) and thrombopenic purpura hemorrhagicum (5 cases).

These patients suffered from a prolongation of the menstrual periods, with excessive bleeding; some of them had periods that were protracted; a few had intermenstrual bleeding as well. In these patients the uteri were either normal in size, or were enlarged to twice the normal size but were symmetrical in outline. In some, secondary symptoms, such as anemia, prostration, or asthenia, were marked.

It is a well known fact that these bleedings may be due to derangement of the internal secretions, such as excessive ovarian function, deficiency of thyroid secretion, or derangement of the function of the pituitary hormones, or may be due to blood dyscrasia, such as infectious diseases, syphilis and so forth, and to thrombopenic purpura hemorrhagicum.

After giving careful consideration to the causative factors, and to the use of medications, such as thyroid and ovarian extracts, iron, arsenic, hemostatic serum, ceanothin and so forth, there still remain three classes

of cases which are deserving of further thought and conservative treatment. These are the bleedings which persist in spite of medication in the younger women—the menorrhagia occurring at the time of menopause, in which thyroid extract, curettage or other measures have given no relief—and thrombocytopenia, which is a clinical entity, and can be controlled by radiation treatment in some cases. It is essential in these cases, of course, that the possibility of malignant disease be eliminated by curettage and physical examination.

Clark and Norris (1), in their book "Radium in Gynecology," say that radium is specific in myopathic bleeding, but that it should be used with a great deal of discretion in young women. This coincides with Burnam's (2) belief that it is specific in these cases and is the method of choice, especially after the age of forty.

Martin (3), as well as Meigs (4), in recent papers, have laid great stress on the endocrine secretions—ovarian, thyroid, pituitary—as probable etiologic factors in uterine bleeding. This is based on studies in recent investigations of the internal secretions, and is rather clearly set forth.

The amount of radiation varies in the hands of different workers, but all are agreed that in patients of 40 years or over, a complete sterilization by irradiation, whether by roentgen ray or radium, or a combination, produces the best results. The problems of younger women, below 35, are more varied, as an effort should be made to preserve the menstrual function if possible. Small doses of radium intra-uterine, giving 300 to 500 mc.-hrs., repeated, have been suc-

cessful. However, in most of our cases in this class of patients, the dose varied from 700 to 1,400 millicurie-hours.

Of our 77 cases, 72 were classified as myopathic bleeding, of whom the four that were treated medically will not be considered in this paper, and 68 were treated by irradiation. Five fell into the class of thrombopenic purpura hemorrhagicum, the treatment of which will be discussed later in the paper. In none of these cases was tumor of the uterus or ovaries demonstrable.

There were 68 cases of menorrhagia of unknown etiology. The ages of these patients varied from 17 to 70 years, as shown in Table I. Five of these women were single, seven of the married women had had no pregnancies, in the others the number of pregnancies varied from one to fourteen, the majority having had from one to six. The blood Wassermann reaction was negative in all of these cases; the Neisser reaction was positive in two cases. Reports on scrapings at the time of curettage were as follows:

- 54 showed endometritis (31 with hyperplasia; 7 polypoid)
- 4 showed cervicitis
- 10 cases, material was insufficient for diagnosis, or no section was obtained.

TREATMENT

The treatment administered consisted of external radiation by high voltage roentgen rays at 80 cm. distance, filter 0.5 mm. copper, 1 mm. aluminum, size of field 20×20 cm., two fields, one anterior and one posterior. It was given in two or four sittings, on successive days. There was little, if any, disturbance, such as nausea, vomiting, or loss of time, from this method. The factors varied according to the thickness of the patient, an effort being made to put 40 to 50 per cent in the ovaries. The same factors were used for "temporary sterilization" in

which 28 to 35 per cent was administered to the ovaries. This was particularly applied to patients below the age of 35, in whom an effort was made to control bleeding, with the hope that menstruation would re-establish itself. Radium tubes were usually used in tandem, inserted into the body of the uterus, filtered through 0.5 mm. gold, 0.5 mm. brass, and 1 mm. rubber, varying according to the distance of the tubes from the ovaries, from 700 to 2,000 millicurie-hours. In cases recorded as having been treated by a combination of radium and external radiation, radium was inserted and allowed to remain for periods of from 700 to 1,400 mc.-hrs., and the total dose supplemented externally by 25 per cent of the skin dose in the ovary, administered by high voltage roentgen rays. These treatments were administered at the time of curettage, which was precautionary, so that malignancy of the fundus would not be overlooked.

RESULTS

Of 68 cases of myopathic bleeding—

- 10 cases treated by roentgen ray and radium
- 2 were lost trace of immediately after treatment
- 8 cases stopped bleeding at once, and there has been no return of menstruation.
- 3 cases were treated by roentgen ray alone
- 1 was lost trace of immediately after treatment
- 1 (age 27) stopped bleeding at once, but normal menstruation was reestablished within the year and she has had three subsequent pregnancies which terminated in three normal children
- 1 stopped bleeding in one

month, with no return of menstruation.

55 cases were treated with from 700 to 2,000 mc.-hrs. of radium inserted into the uterus

4 were lost trace of immediately after treatment

51 stopped bleeding at once. In five cases, 35 years of age and under, normal menstruation was reestablished.

Of the 11 patients who were 35 years of age or less, three were lost trace of immediately after treatment; one, treated with roentgen rays, re-established normal menstruation; five, treated with radium, re-established, and two, treated with radium, did not re-establish menstruation.

Besides these 68 cases of myopathic bleeding there were five cases with rather typical and similar histories of black and blue spots appearing without provocation, and of prolonged menstrual periods, in three cases almost continuous bleeding. In only one of these was there a definite enlargement of the spleen. The ages of these women were from 24 to 31 years, all were married, and all had been pregnant, from one to seven times. In all of these cases the blood platelet count varied from 76,000 to 124,000 before treatment. The bleeding time was prolonged and there was poor retraction of the clot.

TREATMENT AND RESULTS

One case was treated with roentgen rays, over the lateral spleen only, 30 per cent, followed in two and a half months by 20 per cent. A good result was obtained in this case. The patient had cessation of bleeding, with re-establishment of normal menstrual periods in eight months.

One case was treated with high voltage roentgen rays, 25 per cent over the spleen and 25 per cent over the ovaries, and one month later radium tubes intra-uterine, 1,439 millicurie-hours. She has had no bleeding since the last treatment, and is now feeling well.

One patient who had 28 per cent roentgen rays over the ovaries, re-established normal menstrual periods in four months and is feeling well.

One patient who had bleeding two weeks after 30 per cent roentgen ray had been given over the ovaries, was subjected to splenectomy three months after treatment.

One case was given 54 per cent roentgen ray over the ovaries, and radium tubes were inserted intra-uterine for 915.7 millicurie-hours. Following this, she had severe hemorrhages at times, and two months later was given 25 per cent over the spleen. Rather severe bleeding recurred and three and a half months later 54 per cent was given over the ovaries. She complained bitterly of menopausal symptoms, bleeding

TABLE I.—AGE INCIDENCE AT THE TIME OF ADMISSION

Myopathic bleeding

Age period	17-19	20-29	30-35	36-39	40-49	50-54	55-59	60-70
No. cases....	2	5	4	3	35	9	4	6

Thrombopenic purpura hemorrhagicum

Age	24	27	30	31
No. cases	1	1	2	1

having ceased two months after the last treatment. She also had a small fibroid.

CONCLUSIONS

1. Of 68 cases of myopathic menorrhagia, treated by irradiation, 61 were followed and were cured.
2. There was no mortality in the treatment of these cases by irradiation.
3. Five cases were diagnosed as thrombopenic purpura hemorrhagicum. Four were controlled with irradiation alone; one was subjected to splenectomy.
4. A thorough blood examination is essential in the diagnosis of this condition, in all cases in which there is no demonstrable gross pathology.

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ELECTRICAL DEFINITIONS DEALING WITH THE SUBJECT OF RADIOLOGY

These definitions have been prepared under the supervision and are published with the approval of the Sectional Committee on Electrical Definitions of the American Standards Association: Sponsor, American Institute of Electrical Engineers, A. E. Kennelly, of Harvard University, Chairman, and H. E. Farrer, of New York City, Secretary. The Subcommittee Chairmen are as follows:

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These definitions, the Subcommittee Chairman wishes it understood, are submitted tentatively, and he will be glad to receive suggestions from readers of RADIOLOGY.

GENERAL TERMS

Radiology: Radiology is the science and application of roentgen rays, radium rays, or other high frequency rays.

Radiologist: A radiologist is a medical specialist in employing roentgen rays and/or radio-active substances.

Roentgenology: Roentgenology is the diagnostic application of roentgen rays.

Roentgenography (Radiography): Roentgenography is the art of producing radiographs.

Radiation: Radiation is the radiant energy emitted by an X-ray tube, by radio-active substances, or by other sources.

Roentgenogram (Skiagraph, Skia-gram*)*: A roentgenogram is a photographic record of the relative transparency of the various parts of an object to roentgen rays.

Radiograph (Radiogram)*: Radiograph

*Asterisk applied to synonym means that its use is deprecated.

is a record produced on a photographic plate, film, or paper by the action of roentgen rays or radium.

Fluoroscopy: Fluoroscopy is the use in diagnosis, testing, etc., of a fluorescent screen which is activated by roentgen rays.

KINDS OF RAYS

Roentgen Rays (X-rays) Roentgen rays are electromagnetic waves of very short wave length which are set up when the velocities of electrons are altered suddenly.

According to the quantum theory of the nature of radiation, roentgen rays are particles of energy (quanta) travelling linearly at the velocity of light.

NOTE.—“Roentgen rays” is preferred by medical authorities, but “X-rays” is in more general use by physicists. The wave lengths concerned are usually between 0.006 and 1.0 millimicron.

Secondary Roentgen Rays: Secondary roentgen rays are the roentgen rays emitted in all directions by the matter upon which a beam of roentgen rays impinges.

Scattered Roentgen Rays: Scattered roentgen rays are roentgen rays which, during their passage through a substance, have been deviated in direction and also may have been modified by an increase in wave length.

Characteristic Roentgen Rays (Characteristic Spectra): Characteristic roentgen rays are roentgen rays having wave lengths determined by the chemical constitution of the object which emits, transmits, or scatters them.

Fluorescent Roentgen Rays: Fluorescent roentgen rays are secondary rays whose wave lengths are characteristic of the substance which emits them.

Cathode Rays: Cathode rays are streams of electrons emitted from the cathode of an evacuated tube normal to its surface, under the influence of an applied voltage.

NOTE.—By suitable means they can be brought outside of the tube.

Lenard Rays: Lenard rays are cathode rays which have passed outside the discharge tube.

Positive Rays (Canal Rays): Positive rays are streams of positively charged atoms travelling at high speed from the anode of a partially evacuated tube, under the influence of an applied voltage.

PHYSICAL AND INDUSTRIAL APPLICATIONS

Radiometallography: Radiometallography is the radiography of metals.

X-ray Crystallography: X-ray crystallography is the study of the arrangement of the atoms in a crystal by the reflection of X-rays from the atoms of the crystal.

Filtration of Roentgen Rays: Filtration of roentgen rays is the absorption of some of the relatively longer wave lengths of X-ray radiation by placing in its path some absorbing medium such as aluminum.

X-ray Spectrum: X-ray spectrum is the spectrum of a heterogeneous beam of roentgen rays produced by a suitable grating, frequently a crystal.

Minimum Wave Length (Quantum Limit): Minimum wave length is the shortest wave length in an X-ray spectrum. It is definitely related to the maximum voltage applied to the X-ray tube in accordance with the Planck-Einstein quantum equation.

Absorption Coefficient: Absorption coefficient is the ratio of the linear rate of change of intensity of roentgen rays in a given homogeneous material to the intensity at a given point.

Half Value Thickness (Half Value Layer): Half value thickness is the thickness of a given substance which, when introduced in the path of a given beam of rays, will reduce its intensity to one-half of the initial value.

MEDICAL TERMS

Radiotherapy: Radiotherapy is the treatment of disease by the application of roent-

gen rays or the rays from radio-active substances.

Roentgenotherapy: Roentgenotherapy is the treatment of disease by roentgen rays.

Radium Therapy: Radium therapy is the treatment of disease by the use of radium.

Irradiation (Raying): Irradiation is the prolonged application of roentgen rays, radium rays, or other radiation to a patient or other object.

TUBES

Discharge Tube: A discharge tube is a vessel of insulating material (usually glass) provided with metal electrodes, which is exhausted to a low gas pressure and permits the passage of electricity through the residual gas when a moderately high voltage is applied to the electrodes.

Gas Tube: A gas tube is an X-ray tube which depends for its action on the presence of residual gas in the tube, and in which the target is usually connected electrically to the anode.

Vacuum Tube: A vacuum tube is a vessel of insulating material (usually glass) provided with metal electrodes, which is exhausted to a high degree of vacuum.

X-ray Tube: An X-ray tube is a discharge tube or vacuum tube suitable for the production of roentgen rays.

Cathode-ray Tube (Lenard Tube): A cathode-ray tube is a vacuum tube with a thin window at the end opposite the cathode to allow the cathode rays to pass outside.

Geissler Tube: A Geissler tube is a special form of discharge tube for showing the luminous effects of discharges through rarefied gases.

NOTE.—The density of gas is roughly one-thousandth that of the atmosphere.

Crookes Tube: The Crookes tube is an early form of discharge tube devised by Sir

William Crookes and used by him for the study of cathode rays.

NOTE.—The density of gas is roughly one-millionth that of the atmosphere.

Hot Cathode Tube: A hot cathode tube is a vacuum tube in which the cathode is electrically heated to incandescence.

Coolidge Tube: A Coolidge tube is a hot cathode X-ray tube in which the vacuum is so high that the residual gas plays no part in the production of the cathode rays.

Target (Anode, Anti-cathode)*: A target is the metal or plate on which the cathode rays are focussed and from which the roentgen rays are emitted.

Cathode Dark Space—Crookes Dark Space: Cathode dark space is the non-luminous region which envelops and follows the outline of the cathode in a discharge tube at moderately low pressures.

Negative Glow: Negative glow is the luminous glow which envelops the cathode in a discharge tube at moderately low gas pressure.

Kenotron (Valve Tube): A kenotron is an electric valve consisting of a vacuum tube having for one electrode a hot filament.

Thyratron: A thyratron is a form of discharge tube containing mercury vapor and a multiplicity of electrodes, used as an electric valve or to rectify alternating currents.

OTHER APPARATUS

X-ray Machine: An X-ray machine is the transformer, rectifying switch (if any), filament transformer, and controls used in connection with an X-ray tube.

X-ray Apparatus: X-ray apparatus is an X-ray tube and its accompanying accessories, including the X-ray machine.

Electrostatic Generator (Influence Machine, Static Machine, Wimshurst Machine): An electrostatic generator is a gen-

erator which depends upon electrostatic action.

Induction Coil (Coil, Spark Coil, Ruhmkorff Coil): An induction coil is a transformer with open magnetic circuit which is excited by an interrupted or variable unidirectional current.

Interrupter—Break (of an Induction Coil): An interrupter is a device for interrupting the primary current mechanically or otherwise.

Fluorescent Screen (Fluoroscope): A fluorescent screen is a sheet of suitable material coated with a substance which fluoresces visibly when roentgen rays, radium rays, or electrons impinge upon it.

Intensifying Screen: An intensifying screen is a thin screen, coated with a finely divided substance which fluoresces under the influence of roentgen rays, and intended to be used in close contact with the emulsion of a photographic plate or film for the purpose of reinforcing the image.

X-ray Spectrometer: An X-ray spectrometer is an instrument used for determining the wave length of roentgen rays.

Ionization Chamber: An ionization chamber is an enclosure containing two or more electrodes between which an electric current may be passed when the enclosed gas is ionized. It is commonly used for determining the intensity of roentgen rays and other rays.

Penetrometer (Qualimeter, Radiosclerometer): A penetrometer is an instrument for determining the hardness of roentgen rays.

Dosage Meter (Intensimeter): A dosage meter is an instrument for determining the exposure when using roentgen rays for medical treatment.

Oscilloscope: (a) An oscilloscope is an auxiliary discharge tube in which the length of the negative glow affords an indication of the amount of current passing. (b) An oscilloscope is an evacuated tube containing two electrodes, the glow surrounding which

indicates whether the high potential applied is direct or alternating. (c) An oscilloscope is a cathode-ray oscillograph with linear time-axis.

CHARACTERISTIC TERMS

Hardness—Quality (of roentgen rays): Hardness is the penetrating ability, depending on wave length, of roentgen rays. The shorter the wave length, the harder the rays and the greater their penetrating ability.

Hardness (of a gas tube): Hardness is the degree of rarefaction of the residual gas.

NOTE.—The higher the vacuum, the higher the voltage required to cause a discharge with a cold cathode, and hence the shorter the wave length of the resulting roentgen rays.

Intensity (of roentgen rays): Intensity is the X-ray energy passing per unit time through unit area normal to the direction of propagation.

Quantity of Roentgen Rays (Quantity of X-radiation): Quantity of roentgen rays is the product of intensity, time, and cross-sectional area of the beam.

Roentgen (r Unit):* Roentgen is the international unit of quantity of roentgen rays adopted by the Second International Congress of Radiology at Stockholm in 1928. It is the quantity of X-radiation which, when the secondary electrons are fully utilized and the wall effect of the chamber is avoided, produces in one cubic centimeter of atmospheric air at 0°C. and 760 mm. of mercury pressure, such a degree of conductivity that one electrostatic unit of charge is measured at saturation current.

TERMS NOT OTHERWISE CLASSIFIED

Ionization: Ionization is the liberation of electrons from the atoms of a gas.

Ionization Current: Ionization current is

the movement of electric charge produced by the action of an electric field upon an ionized gas.

DEFINITIONS OF TERMS IN ELECTROBIOLOGY,
INCLUDING ELECTROTHERAPEUTICS
(GENERAL)

Electro-culture: Electro-culture is the stimulation of growth, flowering, or seeding by electrical means.

Electrodiagnosis: Electrodiagnosis is the determination of the effect of electric stimulation of nerves, muscles, and organs, and of the electrical resistance of the body.

Electrocution: Electrocution is the taking of life by means of electric current.

BIOLOGICAL TERMS

Electrocardiogram: Electrocardiogram is a graphic trace of the electric current produced by the contraction of the heart muscles.

Galvanotaxis: Galvanotaxis is the tendency of a living organism to arrange itself in a medium so that its axis bears a certain relation to the direction of the current in the medium.

Galvanotropism: Galvanotropism is the growth or bending of a living organism into a certain relation with an electric current.

Electrotonus: Electrotonus is the condition of a nerve or muscle beyond and between the two electrodes when a voltaic current is applied to a portion of its length.

Anelectrotonus: Anelectrotonus is the condition of a nerve or muscle near the anode, and is characterized by flow of current toward the portion to which the electrodes are applied.

Catelectrotonus: Catelectrotonus is the condition of a nerve or muscle near the cathode, and is characterized by flow of current away from the portion included between the electrodes.

Neuro-electricity: (a) Neuro-electricity is electric current generated in the nervous system. (b) Neuro-electricity is a form of energy resembling, but not identical with, electricity.

ELECTROTHERAPEUTIC TERMS

Electrotherapy: Electrotherapy is the treatment of disease by means of electricity.

Electrotherapist: An electrotherapist is a medical graduate who has had special training and has acquired skill in the therapeutic use of electricity.

Electric Sleep: Electric sleep is anesthesia produced by means of Leduc currents.

Electrocoagulation: Electrocoagulation is coagulation by means of a high frequency electric current.

NOTE.—The heat producing the coagulation is generated within the tissue to be destroyed. By this method tissue can be destroyed to any desired depth.

Diathermy: Diathermy is the therapeutic use of a high frequency current to generate heat within some part of the body.

NOTE.—The frequency may be from 750,000 to 3,000,000 cycles per second.

Autocondensation: Autocondensation is a method of applying high frequency currents for therapeutic purposes in which the patient constitutes one plate of a capacitor.

Autoconduction: Autoconduction is a method of applying high frequency currents for therapeutic purposes by electromagnetic induction, the patient being placed inside a large solenoid and constituting the secondary of a transformer.

High Frequency Treatment (D'Arsonvalism): High frequency treatment is the therapeutic use of very high frequency intermittent and isolated trains of heavily damped oscillations of very high voltage and relatively low current.

Faradism: Faradism is the therapeutic

use of an interrupted current for the stimulation of muscles and nerves. Such a current is derived from an induction coil, usually from the secondary, though occasionally from the primary.

Galvanism: Galvanism is the therapeutic use of direct current.

Phoresis: Phoresis is the transmission of chemical ions into the tissues by means of an electric current.

Cataphoresis: Cataphoresis is the transmission of electronegative bodies into the tissues by the passage of an electric current. The flow is toward the negative pole.

Medical Ionization (Ionic Medication): Medical ionization is the therapeutic use of an electric current for the purpose of introducing ions of soluble salts into the tissues.

Fulguration: Fulguration is the destruction of animal tissue by high frequency electric sparks whose action is controlled by a movable electrode.

KINDS OF DISCHARGE

Brush Discharge: Brush discharge is the discharge from a static machine (or less commonly from a high frequency apparatus) having a disruptoconvective character.

Convective Discharge: Convective discharge is the discharge through the air from a high voltage source in the form of visible or invisible streams of charged particles.

Disruptive Discharge: Disruptive discharge is a passage of current through an insulating medium due to the breakdown of the medium under the electrostatic stress.

Effluve: Effluve is a convective discharge of a high voltage current through a dielectric.

Static Breeze (Static Brush): Static breeze is the brush discharge as used in therapy.

KINDS OF CURRENT

Static Induced Current: Static induced current is the charging and discharging cur-

rent of a pair of Leyden jars or other condensers, which current is passed through a patient.

Galvanic Current: Galvanic current is a steady, direct current.

Leduc Current: Leduc current is an interrupted direct current, each pulse of which is approximately of the same current strength and same duration.

Faradic Current: Faradic current is an intermittent alternating current obtained from the secondary winding of an induction coil.

D'Arsonval Current: D'Arsonval current is a high frequency, low voltage current of comparatively high amperage.

Oudin Current: Oudin current is a high frequency current of very high voltage.

Tesla Current: Tesla current is a high frequency current having a voltage which is high, but intermediate between an Oudin current and a D'Arsonval current.

Morton Wave Current: Morton wave current is an interrupted current obtained from a static machine by applying to the part to be treated a flexible metal electrode connected to the positive terminal of the machine, the negative terminal being grounded.

Direct Vacuum-tube Current: Direct vacuum-tube current is a current obtained from a static machine by applying to the part to be treated a vacuum electrode connected to one terminal of the machine, the other terminal being grounded.

APPARATUS

Electrophorus: Electrophorus is a non-rotating apparatus for obtaining static electricity by means of induction.

Oudin Resonator: Oudin resonator is a coil of wire of adjustable number of turns which is designed to be connected to a source of high frequency current, such as a spark gap and induction coil, for the purpose of applying an effluve to a patient.

Spark Ball: Spark ball is an insulating handle having at one end a metallic ball for use in applying static sparks.

Point Electrode: Point electrode is an insulating handle having at one end a metallic point for use in applying static sparks.

Detonating Chamber: A detonating chamber is a muffler surrounding the discharging balls of a static machine or reson-

ator for deadening the sound of a spark discharge.

Electrocautery: Electrocautery is an apparatus for cauterizing tissue, consisting of a holder containing a platinum wire, which may be heated to a red or white heat by a current of electricity.

Hook-up: Hook-up is the arrangement of circuits, electrodes, and apparatus used in giving any particular treatment.

MEDICO-LEGAL DEPARTMENT

THE MEDICAL EXPERT WITNESS

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P., CHICAGO

THERE is probably no occasion or position in which the average physician finds himself at a greater disadvantage than when he is called upon to appear in court as an expert witness. This applies, however, only to those unaccustomed to this service, and not to those who are more or less frequently called upon to act in this capacity.

As long as courts exist and litigants are unable to agree on controversial matters, and where there is a lack of or difference in opinions relative to the normal, pathologic, or anomalous anatomy, function, structure, appearance in health, disease or death, cause of death, etc., physicians will be needed as expert witnesses for the purpose of clearing up moot, debatable, or disputed questions, and to enlighten the court and jury upon these subjects in which they are supposed to be learned and, because of such learning, to be authorities.

Litigation involving health and personal injury, employer's liability and the like, is greatly on the increase, and, because of this, the medical expert witness is becoming more and more in demand.

With courts functioning as they do at the present time, expert medical testimony is practically a necessity, and it devolves upon those best fitted to give such testimony to be well prepared to supply that need. Because so many of the better class of medical men have held themselves aloof and declined to appear as expert witnesses, much of this has fallen into the hands of professional expert witnesses—much to the decided disparagement of the medical profession and, sad to

say, considerably to its derision by the legal profession.

I have heard lawyers say—and I do not doubt it in the least—that they can easily get medical expert testimony to prove anything, any way they may want it proven, and it is a fact, within my own observation, that some physicians (professional expert witnesses) will qualify and testify as surgeons in one court, an hour later as pediatricians in another court, and as psychiatrists in a third court, all within three hours and in adjoining court rooms. I have said about several of these men, that they are specialists on the skin and *its contents*.

To those who are temperamentally and professionally properly qualified to testify as medical expert witnesses, and have made, or are willing to make, a study of this branch of medical service, there are in the larger cities opportunities to be a credit to the medical profession, and at the same time earn remunerative fees without being called out nights, required to keep up expensive establishments, employ high salaried help, etc.; but, if this is undertaken in a conscientious manner, no more exacting line of practice can be projected.

The ideal medical expert witness is a physician who has built up a professional and personal reputation for honesty of character and integrity of purpose, who is widely known and well informed on general medicine, and has a standing beyond any cavil or question in his specialty. Such a man should have a good control of language, a fairly large vocabulary, and be able to express himself clearly. He should, of course, have a

good memory and be able to repeat what he has said on direct examination, a few minutes before. He should be able to answer a question and stop after he has answered it, without going into a history of the last century to qualify his answer. He should have enough perception and knowledge of reading human character to be able to see ahead and possibly anticipate, in his own mind, the point toward which the lawyer questioning him is leading, and he should be keen enough and sure enough of his knowledge not to be trapped into contradiction of his previous statements.

ORIGIN OF MEDICAL EXPERT TESTIMONY

So far as we are able to learn, the calling of physicians as expert witnesses originated in England about 1350, when, during the trial of a criminal, it was found necessary to determine whether a certain injury constituted mayhem, and a physician was called to examine the injured person and testify as to his findings and to render an opinion. This experimental use of expert testimony proved to be so enlightening, added so much to the clarity of the situation, and proved to be so informing that it soon became the custom. Since that time medical expert testimony by physicians has probably been more called to assist the courts and juries to understand technical matters, than has any other class of expert witness.

DISAGREEMENTS AND CONTRADICTIONS

The tendency of litigants, claim departments of insurance organizations, and attorneys (on both sides, of course) is to try to conceal all of the information each side may possess, which if not concealed might help the expert witnesses to further and aid justice. But hiding as much as they can of the facts which they fear might damage their side of the case, only a portion of

the facts are exposed and revealed to the expert witness, at the time that the questions are asked him, his answers elicited, and his opinions go into the testimony in the case. Then the other side presents its evidence, with as much or as little as it feels like revealing, and gets another expert to give an opinion, which because of the manner of asking the questions, as well as the amount of information given, may be diametrically opposite to the opinion and evidence given by the previous witness, although if both were asked the same questions under the same conditions, they would agree in every detail. In that way, the lawyers make us out to be contradictory, incongruous, and given to denying the truth of one another's statements.

A WITNESS SHOULD NOT APPEAR TO BE AN ADVOCATE

Expert witnesses should not appear to take sides in the trials in which they testify, and not in any sense to appear to be advocates. Their only duty should be to give their opinion when asked for it, and to answer the questions which they are asked. Any appearance of advocacy or tendency to champion the cause of either side or become controversial, will lead any open-minded and fair jury to immediately conclude that the witness is taking sides, and his testimony will at once be discounted, and the credence originally given it be markedly lowered or even rendered worthless. We have seen expert witnesses so anxiously trying to create favorable testimony for the side for which they were appearing, that they were almost as bad as the "Alibi Ike," who was ready to swear that he was at lodge, when he was playing poker.

PHRASEOLOGY

Many medical expert witnesses, in an evident effort to create the impression that they

possess great erudition and learning, make use of ponderous, ultra-technical, polysyllabic phraseology, much of which is not understood by any one except the speaker. This effort to throw up a cloud of scientific hokum, to impress their hearers with their great erudition, is usually successful as far as that purpose is concerned, but it does not as a rule help the cause, or clear up the seriously puzzling problem which is the reason for their being there. If medical expert witnesses would give their testimony as nearly as possible in words of one syllable, their testimony would be much better understood, more convincing, and much more useful in furthering the cause of justice.

The average juror knows little or nothing about anatomy or anatomical phraseology, so when a physician mentions the proximal extremity of the third metatarsal bone, or the mediolateral aspect of this or that, it means but little to him; whereas, if the witness had spoken plainly and in ordinary, common language, he might have helped and done some good. To go farthest and serve best, all testimony should be couched in language understandable by the most ignorant person on the jury.

OPINION EVIDENCE AND TESTIMONY

While it is a general rule that opinions of witnesses are considered to be incompetent for evidence, and that witnesses shall not be and are not allowed to express opinions while testifying, this rule is not operative when it is applied to the evidence of expert witnesses, and to what is commonly known as expert testimony. However, expert testimony is admissible in only a certain class of cases; that is, in cases wherein the subject matter of the issue of the case involves questions beyond the range of ordinary knowledge and experience, wherein persons without particular experience or special study would be unable to determine, or in-

capable of formulating a correct opinion relative to the matter or a correct judgment thereon.

Because of these reasons, the opinions of specially trained persons appearing as expert witnesses are declared by the courts and authorities on jurisprudence to be admissible as evidence. In the language of former Chief Justice Shaw, this is "because a man's professional pursuits, his technical skill, and knowledge of science not common to men in general, enable him to draw an inference where men of common experience, after all the facts are proved, would be left in doubt."

When knowledge of the physical or mental condition of some individual becomes important or particularly desirable in a lawsuit, it will readily be seen that facts are liable to be presented which may cause serious questions to arise, which the jury will be incapable of deciding or comprehending, and necessitating the knowledge and experience of a physician for their comprehension and elucidation.

QUALIFYING EXPERT WITNESSES

It must be understood that, because of the technical character of expert medical testimony physicians are expected to give, the witnesses must, before being permitted to give such testimony, show sufficient and satisfactory qualifications to fit them to pass upon the medical matter in question. Therefore, medical expert witnesses, in common with other expert witnesses, are usually asked more or less extended questions appertaining to their knowledge, experience, and qualifications along the lines in which their testimony is to be given.

Often this qualifying examination is comparatively brief and not at all exhaustive, but it is a general rule that any physician appearing as an expert witness is asked questions sufficient to place clearly be-

fore the court and jury his status as a specialist of large experience.

Sometimes, large and extensive experience and specialization are not necessary or required. In some States, one need not be a psychiatrist or specialist in diseases of the mind to give expert testimony as to sanity or insanity. The Supreme Court of Nebraska (in 180 N. W. R. 567) decided that a physician in general practice, who has had experience in cases of insanity, may be entitled to testify on the question of insanity, although he may not be a neurologist or psychiatrist. A similar decision comes from the Supreme Court of Missouri (225 S.W.R. 941).

As a general rule, however, it is necessary to satisfy the court that the witness has the necessary qualifications as an expert, unless the attorneys for both sides agree to accept the qualifications of the witness. This is frequently done by agreement between attorneys, if the witness or his qualifications are well known.

It is also within the province and rights of the presiding judge in some States to refuse to permit a witness to qualify as an expert witness. I have known of professional expert witnesses whose testimony was so notoriously for sale as to have been so refused. There are a few such "black sheep," and it is a good thing that their coats are so colored that they cannot be bleached.

DISCLAIMER OF QUALIFICATIONS

A medical witness may disclaim qualifications as an expert and thereby disqualify his opinion as evidence. According to opinions rendered by Supreme Courts in Mississippi, West Virginia, Massachusetts and several other States, a general practitioner has been held not qualified as an expert witness, to the extent of answering questions pertaining to some special branch of medicine to which he has given no special study and concerning

which he has had neither experience nor observation. Disclaimer of qualifications to testify on the subject of the interrogation by the witness himself, renders his testimony upon that particular subject incompetent and inadmissible.

EXPERTS MUST NOT USURP THE FUNCTION OF THE JURY

Probably the first and most important principle involved governing the introduction of opinion evidence is that the witness must not so testify as to assume the duty of or trespass upon the functions of the jury. For example, the questions asked the witness upon which he is expected to pass his opinion must not be the exact questions which it is the duty of the jury to decide; thus the expert witness must not be asked if in his judgment, based upon the testimony introduced in the case under trial, certain conditions exist, because that would be a matter for the jury to weigh and decide. "It is the function of opinion evidence to assist the jury in arriving at a correct conclusion upon a given state of facts" (180 N.W.R. 815).

HYPOTHETICAL QUESTIONS

The usual manner of ascertaining the opinion of the expert, without permitting him to assume the function of the jury and to pass upon the facts, is the formulation of a question containing the evidence upon which the party to the suit relies, and the truth of which is assumed, for the witness to answer. This is the so-called hypothetical question, which, supposedly embodying the salient and most important points and parts to the desired extent, is propounded to the expert witness and is to be answered by him according to his knowledge and experience.

The attorneys usually frame this type of

question most carefully, setting forth hypothetically all the points upon which they desire the opinion or answer of the expert to be based. The theory of the hypothetical question is that it contains only essential facts of the case, so that when an expert witness is asked an hypothetical question which contains assumed facts, or statements which are not supported or proven by the evidence, there is liable to be an immediate objection by the opposing attorney to the witness answering the question, and if the objection is sustained by the trial judge, no answer is given. It has been held by numerous capable trial judges, and confirmed by higher courts, that if one statement included in the hypothetical question, and therefore supposed to be true, is untrue and not supported by the evidence, the answer and opinion of the entire hypothetical question will be valueless (226 S.W.R. 137).

Expert witnesses do not in all cases testify upon hypothetical statements of facts alone. If the physician has attended a patient whose case is on trial, and understands his condition, he is a proper witness to state such facts and conditions, and after having stated such facts and conditions to the jury he may as an expert express an opinion thereon, provided, of course, that the statutes of the State wherein the trial of the case is held do not provide for and declare that the knowledge acquired by a physician while attending a patient is privileged, and that the patient has not waived the privilege.

The court and jury have a right to know upon what the opinion of the expert witness is based, so that it is an established rule that the presiding judge, the jury, nor the attorneys for either side of the case on trial may ask the expert witness the reason for which his answer was given, and upon what his opinion was based; or the witness may, with permission of the court, explain why his answer or opinion is so given. Details such as these are usually gone into during cross-examination, at

which time the witness may be asked any question tending to test his credibility, accuracy, and memory. He may be compelled to answer questions even though they may tend to injure his character and reputation, except when the answer would contribute to his own incrimination.

An old—but still recognized—authority, entitled, "Rogers on Expert Testimony," lays down rules governing the examination of expert witnesses, as follows:

First, Evidence should be confined to the points in issue, and evidence of collateral facts which are incapable of affording any reasonable presumption as to the principal matter in dispute, should not be received.

Second, Leading questions should not be asked on the direct examination, but may be asked on the cross-examination of a witness. [This may be subject to exception when and where the subject matter of the evidence is complicated and usually does not apply when the witness is hostile.]

Third, In England the rule is that the direct examination and the cross-examination of a witness must relate to the facts in issue, or relevant or deemed to be relevant thereto, while the re-direct examination must be directed to an explanation of the matters referred to in the cross-examination. But in this country the weight of authority is in favor of confining the cross-examination of the witness to the facts testified to in chief. The English rule has been substantially adopted in Massachusetts, Missouri, and South Carolina. In Michigan the English rule has been acted on in practice, and the rulings of the Supreme Court of that State are as liberal as those of the Supreme Court of Massachusetts on the same subject.

Fourth, On cross-examination, a witness may be asked any question tending (1) to test his accuracy, veracity, and credibility, or (2) to shake his credit by injuring his character. And he may be compelled to answer the same, unless such answer would tend to incriminate himself.

Fifth, If, on cross-examination, a witness is

asked a question which is irrelevant only in that it may tend to shake his credit by injuring his character, his answer cannot be contradicted unless, (1) he has denied facts tending to show that he is not impartial, or (2) he has been asked and has denied or refused to answer whether he has been convicted of some criminal offense.

Sixth, The court, in its discretion, may permit a witness to be recalled for further examination. If permission is granted for further examination-in-chief, or further cross-examination, the parties have the right of further cross-examination and of further re-direct examination, respectively.

Seventh, On cross-examination, a witness may be asked as to any former statements which he may have made, and which are inconsistent with his present testimony. If he denies having made them, they may be proven against him.

Eighth, A party is entitled to the cross-examination of a witness who has been (1) examined-in-chief, or (2) according to the English rule, if he has been intentionally sworn.

WEIGHT OF EXPERT EVIDENCE

The effect, credence, and force which are to be given to expert evidence by the jury, in the course of its deliberation, is a question upon which the courts of the several States in this country have been at considerable variance.

A well-recognized line of discussion is to the effect that expert evidence should be received with caution, because, being merely an expression of opinion, it is not entitled to receive the same weight as the testimony of an eye-witness to a fact within his knowledge. This was most clearly put, when the trial judge in a New York case, in his instruction to the jury, said: "When a physician testifies in regard to a fact, you are to believe it just as you are to believe any other man of equal credit. When they tes-

tify to a fact that they know from their study of diseases, and their characteristics, and tell us what there is of the facts, you are to believe it. But when they testify in regard to opinions, it becomes a different question. . . . Everything that these physicians testify to as matters of observation, and by which they are able to tell you the characteristics of the disease, you are to believe as facts, as you would otherwise.

"In considering their testimony, you will consider, in reference to each statement, whether it is a fact or an opinion; you will apply this rule to all facts connected with the case, that are derived from the investigations of these physicians."

On the other hand, other courts have held that expert testimony should be considered like other evidence and given equal weight, while still other courts hold that expert evidence should be given little credence.

In marked contrast to the few instances in which the last expressed view is held, very many courts have stated that the opinions of physicians on medical matters should have great weight, while others have stated that opinions of physicians as to mental capacity, sanity, and insanity are entitled to no greater weight or credence than that of ordinary persons.

Although these widely varying views may seem to be irreconcilable, a careful study of the facts before the courts in the different cases, causes many of the inconsistencies to disappear. The circumstances of the cases, the widely varying conditions of the patients, the widely varying opportunities of the physicians to study the circumstances and conditions relative to which their testimony, the character of their testimony or the opinions which they are called upon to express, may be so at variance as to have an equally widely varying effect in producing these differing expressions of the expert witness's opinions.

MULTIPLICITY OF EXPERT WITNESSES

While many swallows may make summer, a multiplicity of expert witnesses may not make the side that they testify for, right and entitled to a verdict. In a widely quoted case before the Court of Civil Appeals of Texas, in which a number of physicians testified for one side and only one physician testified for the other, and the jury found for the side employing only the one physician, the Appellate Court said: "The jury clearly could accept the opinion of one expert rather than the contrary opinions of many experts. To hold otherwise would be tantamount to holding that a jury's verdict, in order to be upheld, must be in favor of the party offering the greater number of expert witnesses to testify as to its contention" (23 S.W.R. 405).

MEDICAL BOOKS IN EVIDENCE

In nearly all States in this country medical books may not be introduced as testimony or for evidence, but statements by witnesses that their testimony is based upon knowledge acquired by reading medical books are admissible and constitute competent evidence. In several instances in my own experience, extracts from medical books have been read and witnesses have been asked if they agreed with the statements and opinions of the author. Of course, this was done to discredit the witness on each occasion. This plan was once tried on me, by an attorney, who read abstracts from an old and obsolete medical book. I did not agree with the statements quoted from the book and qualified my answer by calling attention to the fact that the book was over twenty years old and that medical knowledge had advanced in that time. When later I was asked in re-direct examination as to what I based my differing opinion upon, I gave the name of a book written by a worldwide authority,

published within a year, and in which I was quoted upon the identical subject under investigation by the attorney who was trying to discredit me. The result proved that his effort and attempt to discredit me acted as a boomerang, the jury finding for the defendant, without leaving their seats.

EXPERT WITNESS FEES

When a physician has been called as an expert witness, he is entitled to a fee commensurate with his standing and prominence in his profession, and in nearly all instances he receives the same. This is particularly true if the witness has prepared himself especially, or has made special investigation.

It is true that a physician is sometimes compelled to answer a subpoena as an ordinary witness, and after his appearance on the witness stand is obliged to testify as an expert, for the statutory *per diem* and mileage; but under such circumstances only impromptu answers to the questions put to him may be demanded.

If the party for whom the expert testimony is to be given, desires that the testimony be backed up by knowledge acquired by special study and investigation, special arrangements as regards compensation should be and generally are made; and any such arrangement or contract, if made, is valid and enforceable. A physician (or other expert witness) having in good faith rendered such services, may enforce the payment for same by suit. If no definite fee has been fixed by agreement, he may recover a fair, just, and reasonable amount for his services.

The Supreme Court of Louisiana held that two physicians who were summoned from the city of New Orleans to appear in Lincoln Parish, to testify in a murder case as expert witnesses, gave their testimony and rendered a bill for \$50.00 per day plus their actual expenses. The trial court allowed them \$25.00 per day and expenses.

The physicians then appealed to the Police Jury to show cause why they should not be allowed the amounts they claimed in full. These physicians stood high in the medical profession as well as in public esteem, and testified that their charge was reasonable, and even less than what was usually allowed them as expert witnesses, and that the amounts of their claims had been agreed upon beforehand. There was no evidence to the contrary. The trial judge held that the amount of their fee was wholly within the discretion of the trial court and that the allowance was reasonable. But the Supreme Court, in its wisdom, held that these experts were entitled to the full amount of their bills, which was the value of their services, and that the evidence showed that this value was at least equal to the amount claimed, in consequence of which, it amended the judgment appealed from, by increasing it to \$229.85 in favor of each physician, the Parish of Lincoln to pay all costs.

There is an Illinois case, wherein a physician, subpoenaed as an ordinary witness in a personal injury case, declined to answer an hypothetical question for the reasons that "an expert witness is entitled to a different and greater compensation than an ordinary witness is allowed, and an expert is not required to give expert testimony without compensation as an expert, unless a reasonable compensation shall have been paid or provided for."

The trial judge fined the physician for contempt of court, which sentence was appealed to the Appellate Court and that court in a long and verbose decision confirmed the decision of the lower court, that physicians must answer questions and give expert testimony even though they were or are subpoenaed as ordinary witnesses and not paid fees commensurate to the value of their services. This was the first time that this question had ever been directly decided by an appellate court in Illinois, and when I

called the attention of some of my medical confrères to it, it caused not a little adverse discussion. Manifestly, the principle that our knowledge—the product of our laborious study and research—is our property, and is as a matter of fact all that we have to sell, is trampled upon by this decision. We have been taught to believe that no one, be he individual, corporation, court, or state, has a lawful right to take away from us that which is our property, without rendering back to us due and just compensation, so, naturally, it irks us to learn that what we have a right to consider our property may be taken from us, and that without proper remuneration. So far as we have been able to learn, we can do little or nothing about it, except in rare instances. I have been able once, so far, to circumvent this decision, and will be glad to explain to members of the Radiological Society how it may be done, if they care to write me.

The witness fees which a party pays to expert witnesses cannot be recovered from the adverse party in the suit, but must be borne by him, irrespective of the final outcome of the trial.

GENERAL POINTS TO BE OBSERVED BY EXPERT WITNESSES

Some general points to be observed by medical expert witnesses who are not accustomed to appearing in court are as follows:

It is usually advisable not to make too prompt a reply to the questions asked. Perhaps one of the lawyers wants to make an objection to your answering. This is particularly true during cross-examination.

It is usually advisable to stop when the question asked has been answered, and it is seldom advisable to volunteer information. If more information is desired, further questions will be asked.

It is *never* advisable to undertake to

answer any question which you do not thoroughly and clearly understand. Ask to have the question repeated rather than do that.

Do not fear the lawyers. Remember that you know much more about medicine than they do and *they know that you know that*. Many of them try to give out the impression that they know a lot about medicine—and other things—but it is almost always a “bluff.”

The following amusing incident occurred a few years ago. I had been called as an expert witness to give an opinion as to whether or not a fracture was shown in certain roentgenograms of the cranium, introduced as evidence. The examining attorney on the opposite side of the case was a dapper, conceited young fellow, who seemed to be nettled at my positive, sure-of-myself manner of answering the questions, and in cross-examination evidently determined to catch me, and discredit my testimony, which he manifestly considered was damaging his case. He repeatedly and in various ways asked me about my qualifications, particularly in relation to my knowledge of anatomy, and finally asked me if I could give him the location of some obscure ganglion—naming it. My prompt reply that “It is between the parietal bone and the os calcis” completely satisfied him. A medical friend of mine, who happened to be present, stuffed his handkerchief into his mouth and hurriedly left the court room.

Do not be ashamed or afraid to say that you do not know. No man is expected to know all there is to medicine any more than any one man is expected to know all there is to law, biology, astronomy or any other subject.

Do not become confused, agitated, or excited by the attempted intimidation or interruptions of the attorneys. It is frequently their purpose to try to confuse or excite witnesses by repeated interruptions, so as to

cause them to contradict their previous statements or misstate something.

Do not be an advocate for the side for which you appear. Do not appear to favor either side. Your place is to tell the truth as you see it and *that only*, and not to try to influence the court or jury to any greater extent than that truth will or should. It is the lawyer's business to argue the case and not the business of witnesses to do anything except give testimony. Do not be controversial.

Do not be too technical in your answers to questions. Use the same sort of language that you would to ten-year-old children, because there may be jurors listening to you whose mentality is that of a ten-year-old. Use words that are in general use and as far as possible refrain from the use of technical terms.

As a rule, it is not advisable to become facetious. Jokes may be misunderstood and at best they tend to lower the dignity of the procedure, and cause one to lose caste, particularly with ignorant persons.

Speak slowly, and show that you mean what you say. Be convincing. Give out the impression that you are sure of yourself and unafraid.

If you are asked if you expect to be paid for your services, do not hesitate to say “yes” (if you do), and if asked the amount do not be at all backward in naming it (if it has been agreed upon). No sensible person expects you to donate your time, experience, and knowledge except to a deserving charity, and you need not be ashamed to place a high value on your services. The lawyers do this for their services.

Observation of these few points, and the maintenance of the usual presence of mind and calmness, such as you are wont to display in your daily routine of practice, are all that are necessary to make an excellent witness of any physician.

REPORTS OF CASES INVOLVING RADIOLOGICAL MATTERS¹

Myeloma Attributed to Trauma (Loveless vs. Red Top Cab Co. (Wash.), 291 P.R. 344).

—Loveless was injured by a taxicab operated by the defendant company. He instituted suit for damages but died before the case was tried. His wife, as administratrix, was substituted as plaintiff. The trial court gave judgment in her favor, which judgment was affirmed by the Supreme Court of Washington.

Prior to the accident, Loveless was in good health. The injuries complained of were received Aug. 6, 1928. Loveless, while crossing the street, was struck by a taxicab, the front fender hitting him in the lower part of the back. He fell on the fender and then to the street. He was taken to a hospital, where he remained for two or three days. He continued under the care of a physician, however, for three or four months. About three weeks after the accident, his health began to fail. About a month after the accident, pain developed in the lower part of his back. This became more acute as time went on and was attributed by his physicians to arthritis of the spine. About the middle of December a roentgenogram showed a slight mottling or coloring in the lower spine. From the time when his health began to fail, three weeks after the accident, his condition grew gradually worse, and for three or four months prior to his death he was confined to his room and most of the time to his bed. April 13, 1929, he developed pneumonia. He died three days later. An autopsy showed a myeloma in the lower part of the spine.

A physician testifying for the plaintiff stated unequivocally that in his opinion the myeloma was caused by the accident. Another physician, also testifying for the plaintiff, felt confident that the injury at the very least predisposed to the development of the myeloma and was a factor in its causation. Physicians called by the defendant testified that the myeloma was not caused by the accident. Taking

into consideration the history of the case, said the Supreme Court, together with the evidence of the two physicians who testified for the plaintiff, there was substantial evidence to take to the jury the question whether the myeloma was or was not caused by the accident.

Physicians called by the plaintiff testified that the primary cause of death was the myeloma and that the pneumonia was the terminal cause. Physicians called by the defendant testified that the pneumonia was the primary and proximate cause of death. From what was disclosed by the autopsy, it was apparent that death was rapidly approaching even if pneumonia had not appeared. Whether death was caused proximately by the myeloma or by the pneumonia was a question of fact to be determined by the jury. Where the original act is wrongful and would naturally in the ordinary course of events produce death, as the jury had a right to find in this case, the occurrence of pneumonia as the terminal cause does not relieve the defendant from liability.

Diagnosis as Part of Treatment (Hester vs. Ford (Ala.), 130 So.R. 203).—The plaintiff, Hester, injured his ankle. No X-ray machine was available, and the plaintiff refused to take an anesthetic. The defendant physician therefore administered morphine and examined the injury by sight and touch. He found a fracture of the tibia at the joint, set it and applied splints. Several weeks later a roentgen examination showed that the fibula was fractured some two or more inches above the joint and that the fragments overlapped. An operation was necessary. Thereafter the plaintiff sued the defendant for malpractice. One of the counts of the plaintiff's complaint charged that the defendant negligently failed to use in and about "said diagnosis and treatment" of the plaintiff's injury reasonable care, skill, or diligence. Another count charged that the defendant failed to use in and about "said diagnosis" of plaintiff's ankle such care, skill, or diligence as was reasonably necessary to ascertain the character of the injury. Judgment was rendered in favor of the defendant physician. The patient appealed to the

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Supreme Court of Georgia, which affirmed the judgment in the physician's favor.

Apparently, the principal error of the trial court urged on behalf of the patient was the following instruction to the jury:

"Unless you are reasonably satisfied from the evidence that the defendant failed to exercise reasonable and ordinary care, skill, and diligence in the *treatment* of the plaintiff's broken leg and foot, you cannot find for the plaintiff."

This instruction, argued the patient, would excuse the physician from negligence in diagnosis. In common parlance, said the Supreme Court, and often in the law, "treatment" is the broad term covering all the steps taken to effect a cure of the injury or disease. It includes examination and diagnosis as well as the application of remedies. The patient's complaint, it is true, spoke of diagnosis and treatment as distinct. The sense in which terms are used in a charge to the jury need not necessarily conform to the sense in which they are employed in the pleadings; they may become misleading in a given case and call for an explanatory charge. But the giving of this instruction is to be justified on broader grounds. While both counts of the complaint charge negligence in "diagnosis" as a proximate cause of the injury, the only causal connection between such negligence, if any, and the injury was improper treatment, or failure to apply the right treatment because of such bad diagnosis. Neither bad diagnosis nor want of diagnosis alone was sufficient. If the proper treatment was applied, no injury would result no matter what the diagnosis. If the proper treatment was not applied, because either of negligence in diagnosis or of other want of ordinary care, skill, or diligence, that treatment would be "negligent," using "treatment" in the limited sense of the complaint. Negligence in "treatment," either in the inclusive or limited sense, was essential to the plaintiff's recovery of damages.

Expert Opinion on Roentgenogram Not in Evidence (Lefebvre vs. Western Coal and Mining Co. (Kan.), 289 P.R. 456).—A physician may not testify concerning what was

shown by a roentgenogram that is not produced in court. The contention that the roentgenogram is a part of the hospital records and cannot be taken from the hospital presents no adequate excuse for a failure to produce it. There is no rule of law that places hospital records in a privileged class. They can be produced in court the same as the records of a corporation or any other records, corporate or private, that may be necessary to further justice between litigants. The roentgenogram should be produced in evidence so that the other party to the case may use it for the purpose of cross-examination and submit it to his own medical experts for examination, to enable them to testify as to their interpretation if they disagree with the expert who interpreted it on behalf of the party relying on it. A medical expert may not testify as to the cause of a person's physical condition or injuries, when his testimony is based in part on a report made to him by another physician or on information that he derived from private conversations with a third party.

Testimony of Expert Witnesses Appointed by Court (Vey vs. State (Ohio), 172 N.E.R. 434).—A mandatory provision of a statute that "the judge of the trial court shall appoint one or more disinterested qualified physicians . . . to testify as experts" does not make it mandatory that the experts so appointed be called to testify at the trial. The intention of the legislature in passing such a statute was to make expert testimony neutral and disinterested and to remove the evil often arising because of partisan expert testimony. Under the statute the appointment of experts is unquestionably mandatory, but the actual calling of the experts to testify is discretionary with the court. It often happens that court-appointed experts have formed no opinion. In such a case there would be no purpose in calling the experts merely to testify to that fact.

Fracture of Vertebra by Chiropractor (Witt vs. Reed (Okla.), 289 P.R. 291).—Reed, suffering from an "ordinary cold in his head," employed Witt, a chiropractor, to treat him. Reed alleged that he was injured by the

treatment. He, therefore, sued the chiropractor and obtained judgment. From this judgment the chiropractor appealed to the Supreme Court of Oklahoma, where the judgment was affirmed.

Reed alleged, among other things, that the chiropractor, in disregard of the ordinary skill used by ordinarily skilful practitioners of chiropractic, negligently and unskilfully failed properly to diagnose his physical condition and unskilfully and negligently applied a greater amount of force to his, Reed's, body than was reasonably necessary under the circumstances, thereby permanently injuring him. Describing one particular treatment, Reed alleged that the chiropractor requested him to sit upright on a small bench, placed his knee against Reed's back, and, after bracing himself, reached his arm around Reed's head and gave the head a quick jerk. Immediately, Reed, the patient, suffered a sharp pain in the region of the fourth cervical vertebra. This continued to grow in intensity and severity until the evening of the following day. Then the pain became so severe that a physician was called. Reed continued to grow worse, becoming delirious and almost totally paralyzed. The second, third, fourth, and fifth cervical vertebrae, Reed claimed, had been injured and dislocated and he himself permanently injured. A roentgenologist testified that roentgenograms taken by him showed almost complete destruction of the spinous process of the fourth cervical vertebra, a fracture through the body of the fifth cervical vertebra, and a callus on part of the upper surface of the sixth thoracic [sic] vertebra. The trial court instructed the jury that before it could decide for the patient it must find that the chiropractor failed to use such ordinary care and skill as were used by his school of practice and that such want of ordinary skill and care was the proximate cause of the patient's injury. The jury was further instructed that if the chiropractor bestowed on the patient such reasonable and ordinary care as a physician in the same line of practice would ordinarily have bestowed in such a case, then the patient could not recover and the verdict must be for the chiropractor. In these instructions the Su-

preme Court found no error. The jury, concluded the court, evidently found from the evidence that the chiropractor did not use such ordinary care and skill in his treatment of the patient as were used by practitioners of the same character.

Admissibility of Hospital Records (Sullivan vs. Morse (Mass.), 171 N.E.R. 668; Calhoun vs. Morse (Mass.), 171 N.E.R. 668; Connors vs. Morse (Mass.), 171 N.E.R. 668).—The general rule is that if a document, such as a hospital record, is offered in evidence and found admissible in part, the entire document should be admitted. The same rule prevails where a document not strictly admissible is admitted in evidence by agreement. Irrelevant matters, however, although a part of an otherwise admissible conversation set forth in the document, should be excluded, notwithstanding the general rule that the entire document or record should be admitted.

Care and Skill Correlated (Rothschild vs. Barck (Mo.), 26 S.W.R. (2d) 760).—The physician owed the plaintiff a duty to exercise ordinary care and skill. His failure to exercise either would be negligence. If he was incompetent and attempted an operation which he knew he could not perform, it would be negligence. So the term "negligence" covers not only a lack of care but also failure to exercise skill which the person possesses and the attempt to exercise skill which he knows he does not possess.

Appointment of Expert Witnesses by the Court (Jessner vs. State (Wis.), 231 N.W.R. 634).—In Wisconsin, in any criminal case, whenever expert opinion evidence is necessary or desirable the trial judge may appoint one or more disinterested qualified expert witnesses (Wis. Stats., sec. 357.12). The fact that such expert witnesses have been appointed by the court must be made known to the jury, and the witnesses are subject to cross-examination by both parties. The court may commit an accused person to an asylum for observation by all interested experts.

Jessner was convicted of murder, after court-appointed experts had testified concerning his sanity. He appealed to the Supreme Court of Wisconsin, alleging that the statute under which those experts had been appointed had deprived him of various constitutional rights. The statute, he complained, undertakes to authorize such an observation, examination and investigation of the accused as constitute an invasion of his right of privacy, guaranteed by constitutional prohibitions against unreasonable search and against compulsory self-incrimination.

If the statute under consideration, said the court, attempts any violation of the constitutional rights of an accused person, it must be through that provision that authorizes his commitment to a hospital for observation. It does not follow, however, that, because a fact pertains to or is connected with the person of one who is accused of crime, that fact is necessarily a secret; personal characteristics which are commonly open to and observable by all persons are not of that secret nature which the constitutional prohibitions here discussed are designed to protect. This statute should not be construed, if it is possible to construe it otherwise, as a legislative attempt to compel an accused person to submit to an unconstitutional inspection or investigation. It is construed here, said the Supreme Court, as authorizing the court-appointed experts to make only such investigations and examinations as are consistent with the constitutional rights of the accused, but no attempt will be made at this time to set the limits of such rights. In the present case, said the court, no matter what the constitutional rights of an accused person may be, there is no contention that they were violated. The appointment of experts by the court and their examination of the defendant were by and with the consent of the defendant. Their testimony, therefore, cannot be said to be based on knowledge obtained as the result of any violation of the constitutional rights of the accused.

The defendant contended further that the statute authorizing the appointment of expert witnesses by the courts violates that provision of the Wisconsin constitution that guarantees

a jury trial, since the witnesses appointed by the court must be identified to the jury as court-appointed experts. This, he contended, makes the court stand sponsor for the credibility and reliability of such experts. The "jury" guaranteed to the defendant by the Wisconsin constitution, however, the court said, is such a jury as was known by the common law in the courts in the territory of Wisconsin before the state was organized. The only limitation which the common law imposed on the trial judge in the matter of expressing his opinion with reference to the merits of a case was that he should make it clear to the jury that they were not bound by that opinion and that their decision on the facts rested exclusively with them. Whether the sponsoring of any witnesses by the court is good public policy, however, is no longer a matter of judicial opinion: the dominant opinion of the Wisconsin legislature on the subject has received expression in this statute, and such an expression on matters of public policy prevails unless it contravenes some constitutional provision. There is no constitutional provision in Wisconsin relating to jury trials which prohibits the practice prescribed by the legislature in this statute.

The conviction of the defendant was affirmed.

Liability of Third Person for Medical Fees (Swarens vs. Pfnisel (Mo.), 26 S.W.R. (2d) 951).—Pfnisel was burned in a gasoline explosion in the course of his employment. His cousin, Mrs. Amel, with whom he boarded, requested Dr. Swarens to render medical services and promised to pay his bill. Pfnisel was unconscious when Swarens first visited him and at no time said anything to Swarens about employing him. Swarens, however, did not charge Mrs. Amel on his books for his services; he made the charge to Pfnisel. He rendered no bill to Mrs. Amel, but when his services ended, he, at Mrs. Amel's request, delivered his bill, made out against Pfnisel, to Pfnisel's attorney, who was negotiating for a settlement with the insurance company by which Pfnisel's employer was insured. Swarens' bill was not paid, so he sued Pfnisel

and Mrs. Amel jointly. Judgment was rendered against both of them, but Mrs. Amel appealed, ultimately carrying the case to the Supreme Court of Missouri, Division No. 2.

Mrs. Amel contended that her promise to pay Swarens for his services was void, because it was not in writing, since the statute of frauds provides that "no action shall be brought to charge . . . any person upon any special promise to answer for the debt, default or miscarriage of another person" unless the agreement is in writing. Her contention, said the Supreme Court, was well taken, citing *Price vs. Chicago, M. & St. P. Rd. Co.*, 40 Mo. App. 189, to show that if the beneficiary under a promise is liable at all, the promisor not being solely liable, the promise comes within the statute. Ordinarily, said the court, the question as to whom credit was given is one for the jury. The fact that Swarens' charges on his books were against Pfnisel alone, and not against Mrs. Amel, might not be controlling as a matter of law. The fact, however, that he sued both Pfnisel and Mrs. Amel, alleging that he had rendered services at the instance and request of both of them and prayed judgment against both shows beyond any question that credit was given to some extent at least to Pfnisel. In view of his conduct, Swarens cannot say that credit was extended Mrs. Amel alone. The fact that Swarens presented a bill made out to Pfnisel to Pfnisel's attorney tended further to prove that credit was extended in part at least to Pfnisel. The court held, therefore, that the promise made by Mrs. Amel came within the statute of frauds and was void because it was not in writing. The judgment of the court below, against Mrs. Amel, was reversed.

Sarcoma of a Bone Attributed to Trauma (Halper vs. The Golden Rule (Minn.), 231 N.W.R. 195).—Minnie Halper, a clerk in the Golden Rule Department Store, Oct 23, 1928, was carrying a box weighing 44 pounds. It fell and struck her on the inner side of her leg, "just below the point of the knee." The blow left a red mark, which turned blue and black. Her leg pained her for a few days, and then apparently it seemed normal. A few weeks

later the leg pained her again and began to swell at the place of the injury. December 29, she complained of the pain, to the nurse in the hospital or rest room at her place of employment, whom she had occasion to consult about another ailment. She did not associate it, however, at that time, with the injury she had suffered, nor did she do so until after the physician whom she first consulted, February 2, questioned her. Roentgenograms taken after that consultation showed that the bone was affected. An incision was made, February 10, and material was removed for microscopic examination. One pathologist thought that the examination disclosed a sarcoma; the other thought that it did not. Another examination, March 13, resulted in a definite diagnosis of sarcoma. The leg was amputated, April 17, three inches above the knee. The industrial commission awarded compensation for the loss of the leg. The employer and its insurance carrier brought the case by writ of certiorari to the Supreme Court of Minnesota.

The medical witnesses agreed, said the Supreme Court, that no one knows positively what causes sarcoma, or whether it may result from trauma. One physician testified that in a majority of sarcoma cases there had been a previous, comparatively trivial injury, the effects of which passed away, only to be followed by a sarcoma. Another testified that a large percentage of patients having sarcomas give histories of previous trauma. Both believed that the sarcoma in the present case resulted from the injury. The sarcoma developed in the exact point of the injury, and there was nothing to indicate any other cause. In the opinion of the Supreme Court, the evidence justified the industrial commission in inferring that the sarcoma resulted from the injury. The order of the commission was therefore affirmed.

Admissibility of Roentgenograms Taken on Antiquated Machine (Garvey vs. Chicago Rys. Co. (Ill.), 171 N.E.R. 271).—A physician, specializing in radiology, testified that he personally took and developed the roentgenograms, concerning which he testified, of the cervical

spine of the plaintiff. The roentgen-ray machine that he used, he said, was "not in very good working order"; it was an old machine and had seen its best days. He did not use a fluoroscope. The roentgenograms were, however, he testified, a correct representation of the plaintiff's cervical spine. The appellant, defendant in the court below, contended that under the circumstances stated the roentgenograms were not competent evidence. In the

absence of other convincing proof tending to establish accuracy, said the Supreme Court of Illinois, it would certainly be improper to admit roentgenograms shown to have been taken on a machine not in "good working condition," but no absolute rule has been laid down making roentgenograms taken on such a machine inadmissible regardless of other testimony and considerations. In the present case, the evidence was properly admitted.

PREDICTS HUMAN LIFE WILL BE NO LONGER BUT HEALTHIER

The span of human life, the actual number of years which an individual may attain, will probably not be lengthened much beyond its present limit; yet the sixty years of the present span of life will be lived in much greater health and happiness, it has been predicted by a speaker before the American Philosophical Society.

Man is a reasoning animal, however, the speaker pointed out, and his future will not be merely the struggle for existence. His adapta-

tion to his environment and his conquest of that environment thus far make it impossible to predict that he will not go farther along those lines and push ahead the extent of his life span. . . . Further application of present scientific knowledge will make the average man's life not only longer, but healthier. Unnecessary disease must disappear. Death must no longer come in childhood. Debilitating, incapacitating illness must be postponed. Each of us should have the hope of growing old gracefully, in the possession of his mental and physical powers.—*Science Service.*

PROCEEDINGS OF WIENER GESELL-
SCHAFT FÜR RÖNTGENKUNDE

FEB. 3, 1931

AN AUTOMATIC REVERSING MILLIAMPERE
METER FOR LIMITED EXPOSURES

DR. SPIEGLER: Most diagnostic roentgen examinations at the present are those in which fluoroscopy and radiography are combined. In changing from fluoroscopy to radiography and *vice versa* the measuring range of the milliamperage meter must be changed. If this is not possible, there are two alternatives; either the scale must be set for high milliamperage reading or for low. If the instrument be set for high reading, it is most difficult to secure accurate readings on low milliamperages, and in this event the fluoroscopist may unwittingly use a much higher current than he wishes to use. On the other hand, if the instrument be set for low reading, there is great danger that it will be injured by higher current. Because of lack of time the change in measuring scope is often not made, and consequently injury to either the apparatus or the operator may result. If the change could be made by the operator without shifting his position, although the disadvantage of time lost would be overcome, there would still remain the objection that very careful attention be paid to the instrument. All these disadvantages are overcome by an instrument which the author demonstrated. It is an automatic milliamperage meter, so constructed that for small currents the small scale and for large currents the large scale is automatically used. For fluoroscopy and therapy the small scale is always used, but if a radiograph is to be made the large scale is automatically used, and, in addition, this is made known by a signal light. The change from fluoroscopy to radiography can be rapidly executed without any necessity for the operator to direct his attention to the apparatus. Any

of the existent milliamperage meters can be built into such an automatic apparatus by inserting a relay connection into the existent shunts; this also supplies current for the illumination of the dial.

DISCUSSION

PROF. HOLZKNECHT: The simple and refined solution of the technical problem I regard as Columbus did the egg. I had not dared to submit this problem to a technician for I felt that it could not be solved. I have always felt the great need for such an automatic arrangement.

DR. FLEISCHNER discussed what he felt to be a technical disadvantage of this apparatus.

SIX CASES OF OVARIAN CARCINOMA COMPLICATED BY STENOSIS OF THE SIGMOID

DR. POHL: Of the six cases, four were proved at autopsy, one at operation; the other case is still under treatment. These cases were observed in the course of a year at Prof. Haudek's Institute. It is worthy of note that in the same period of time a similar change, due to another condition (metastasis from carcinoma of the cecum), was found in only one case. The symptoms of each of the author's patients were almost exclusively referable to the intestinal tract. More than half had been diagnosed as large bowel carcinoma, peritonitis, etc. In three cases it was possible to exclude by roentgen examination a primary intestinal process. There were perisigmoidal changes producing a narrow lumen; an adnexal tumor was, therefore, thought to be the cause and its presence was proven by autopsy. The stenoses had the following characteristics: The stricture involved either the rectosigmoid flexure or a large portion of the sigmoid. Usually the stenosis is rather long, the narrowing marked. There was not the simple narrowing of the usual type of steno-

sis, or compression from one side, or a circular constriction. The picture in these cases was one of marked narrowing of the bowel lumen, with distortion and angulation; between the narrowed portions there were localized dilatations. The mucosa was continuous throughout the entire area, but there were bizarre deformities of the mucosal outline in the tortuous portions. Due to the marked stenosis, it was sometimes difficult to secure good visualization of the mucous membrane relief. Further study of ovarian carcinomas revealed several facts.

(1) It is difficult and often impossible to determine by examination which ovary is involved, since either may be displaced.

(2) Distant metastases are infrequent, extension usually being by implantation.

(3) In the true pelvis evidence of compression of the bowel develops early, since the structures are so limited by the surrounding bone.

Without doubt a number of processes other than ovarian carcinoma may produce similar stenotic lesions of the bowel. In women, however, a thorough gynecologic examination should be made if such a condition be found. In describing this condition it is well to call it a stenosis of the bowel with intact mucosa, rather than a benign stenosis.

HISTOLOGIC CHANGES IN AN IRRADIATED DOUBLE CARCINOMA OF THE UTERUS

DR. WINDHOLZ: A 37-year-old woman was subjected to intensive irradiation therapy because of vaginal bleeding apparently caused by a fibroid. The last treatment series had been given eight months previously. As a consequence of prolonged bleeding a total hysterectomy was performed two months after the last irradiation. Study of the operative specimen revealed in the anterior wall of the corpus uteri a coarse-grained, greenish-white tumor,

the size of a plum, which was not circumscribed. Histologically it showed the structure of a double carcinoma, composed of both squamous and cylindrical epithelium. In the interstitial structures of the tumor and in the myometrium there were numerous miliary epithelioid cell tubercles. In portions of the tumor which had an identical biologic environment and were subjected to the same irradiation factors, the squamous epithelium showed extensive degenerative changes; whereas, in the cylindrical epithelium little change could be found. In the midst of the degenerative squamous epithelium were seen well nourished, apparently newly developed strands of cylindrical epithelium, with many mitoses. In the region of the degenerating squamous epithelium there was predominately a giant cell and leukocytic mesenchymal reaction, while about the cylindrical epithelium the reaction was chiefly of plasma cells and polymorphonuclear leukocytes. The author feels that there is a qualitative and quantitative difference in the reaction of the two cell types to irradiation and a different growth potential.

DISCUSSION

DR. BORAK explained that a curettage had not been performed because of the patient's relative youth. The possibility of carcinoma had, therefore, not been seriously considered.

DR. R. PAPE stated that it was quite possible that the two types of tissue were not of the same age, since the one might have appeared earlier than the other. If this were true, both cell types were not subjected to the same biologic and radiotherapeutic factors as the author had suggested. He called attention to the fact that squamous-cell carcinoma of the portio uteri reacts favorably to radiation therapy in contrast to adenocarcinoma of the corpus, in which poor results are obtained.

DR. WINDHOLZ: In photomicrographs which had been exhibited both squamous and cylindrical epithelium could be demonstrated in the same alveolus of the cancer; they were separated only by the thickness of

a cell membrane. The author felt that this was conclusive proof of the identical age of the two tissue structures. Hence, both must have come under the same environmental influences.

ELECTRIC SEPARATION CARRIES ELECTRONS THROUGH AIR SPACE

Electrolysis, or electric separation of the elements in a chemical solution, is carried on in a new way by a process invented by Prof. Alfons Klemenc, of the University of Vienna. The method promises results of great importance in research, and possibly also in industry.

In ordinary electrical separations, both positive and negative electrodes are immersed in the solution to be treated, and each takes out

the atoms or atom-groups that are attracted to it. In Prof. Klemenc's process, the negative electrode is suspended above the surface of the liquid, and separated from it by an air space. When the current is turned on, a stream of electrons is given off by the electrode into the air.

The electrical phenomena that accompany this kind of electrolysis are quite different from those of ordinary electrolysis, Prof. Klemenc states. Electrolytic reduction is carried on more easily, and electrolytic oxidation proceeds much more intensely.—*Science Service*.

CASE REPORTS AND NEW DEVICES

A CASE OF ANEURYSM OF THE ABDOMINAL AORTA

By C. C. McCLURE, M.D., Cleveland Clinic
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Since cases of abdominal aneurysm in which the symptoms are suggestive of renal stone are rather infrequently encountered, and also because the aneurysm is rarely found to have penetrated through the diaphragm, it is believed that the following case history will be of interest.

A man, 46 years of age, entered the Clinic complaining of "kidney trouble" and back-ache. The symptoms had been noticed, first, nine months previously, at which time he experienced pain in the kidney region of the left side and back, radiating downward

to the flank, the distress persisting for several days. He had frequency but there was no hematuria. The pain had subsided after the patient's physician had given him a dose of medicine and he apparently remained well until five days before he entered the Clinic, when another attack occurred; since then, the pain had been severe and constant. Relief could be obtained only by standing and leaning to the left side. The patient had lost fifteen pounds in weight.

The personal history revealed nothing of significance, and upon physical examination no gastro-intestinal symptoms were found to be present. There were no significant findings in the urologic examination, except for signs which led to the suspicion of an



Fig. 1. In this roentgenogram the arrow points to the aneurysm which has penetrated from the abdominal cavity into the pleural cavity.



Fig. 2. Roentgenogram showing the aneurysm considerably increased in size and extending higher. This roentgenogram was made several months after that shown in Figure 1.



Fig. 3. Roentgenogram showing marked erosion of the bodies of the lower dorsal and upper lumbar vertebræ.

aneurysm of the left renal artery. There was no shortness of breath, no palpitation, no edema. The pulse rate was 120 and the blood pressure 150/100. A general examination of the chest showed nothing of significance and no masses could be palpated in the abdomen.

A diagnosis was made of left kidney stone, neoplasm of the left kidney, arteriosclerosis and hypertension, and the patient was advised to enter the hospital.

A roentgenographic examination of the abdomen by means of pneumoperitoneum disclosed a large abdominal aneurysm.

On February 11, 1929, under spinal anesthesia, a left oblique lumbar incision was made and the left kidney exposed. No evidence of a tumor or a stone was found, but the lower pole of the kidney was soft. The kidney was removed. Just above the kidney area and beneath it, a pulsating mass could be seen from which dark blood flowed after a needle was inserted. This mass was

believed to be an aneurysm of the abdominal aorta originating just below the diaphragm. As it was not possible to institute surgical treatment for this condition, the wound was closed. The patient made an uneventful recovery.

On November 11, 1930, the patient returned to the Clinic complaining of pain in the left lumbar area from which he had suffered for several months. There was marked restriction of movement in the upper lumbar area. Roentgenographic examination showed the bodies of the first lumbar and the eleventh and twelfth dorsal vertebræ to be about half destroyed by the aneurysm. Marked right scoliosis was noted.

On December 12, 1930, a roentgenographic examination of the gastro-intestinal tract showed no evidence of a pathologic condition either in the stomach or colon. Upon fluoroscopic examination it was found that the large, pulsating mass had extended through the left side of the diaphragm. During respiration the diaphragm was seen to slide up and down the mass; during deep inspiration the mass seen in the lower left pneumonic field appeared to be much larger than during expiration. Figure 1 shows the level at which the tumor penetrated the diaphragm. The pneumoperitoneal films are not available, having been destroyed in the Clinic fire in May, 1929; however, they showed that the tumor was well below the diaphragm, and the evidence was confirmed at operation.

The patient was advised to take as good care of himself as possible and when last heard from he was working.

Aneurysm of the abdominal aorta is of comparatively uncommon occurrence. The symptoms frequently resemble those of lumbago, intestinal or kidney trouble, or malignancy. In 1895, Croly and Graves, of Dublin, reported a case in which the symptoms were referable to the left kidney and

the aneurysm ruptured into the left pleural cavity. Diagnosis of aneurysm was made at autopsy and the diaphragm was found to be ruptured. This case was apparently one of a "rupture through the diaphragm" and not an "erosion through the diaphragm," as in the case reported here.

The diagnosis of abdominal aneurysm is often difficult, is frequently not made before operation, and often only at autopsy.

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TECHNICAL POINTS FOR ROENTGENOLOGISTS

By CARLOS HEUSER, M.D.

BUENOS AIRES, ARGENTINA

Translation by N. G. GONZALEZ, M.D.

Centralization of the Tube Over the Body.—It is difficult to so adjust the tube over the body as to make a film of the lung



Fig. 1. Before taking the radiograph, the clothespin is placed on the nose and the patient is ordered to close his mouth during inspiration or expiration, according to whether the radiograph is desired on the former or the latter.



Fig. 2. To take a radiograph of the esophagus during the act of swallowing, the patient is placed on the table, with a glass beside him containing an opaque meal. He then draws up the contents of the glass by placing a tube or pipette against his teeth and sucking up and swallowing the contents. Several radiographs are taken during this process.

or any other part, particularly when one wishes to repeat a film previously made, either for the purpose of making a second radiograph or to locate the duodenum when fluoroscopy is not done. This inconvenience is solved by placing in the filter support a piece of cardboard 2 mm. thick, in the center of which a hole about 3 mm. in diameter has been made. This hole must be in the center of the circumference of the rays projector and in the tube support of the tube producing the rays. The cardboard is placed in the aluminum plate holder used for radiotherapy. Placed in this position, the filament is then lighted. It is observed that two shadows are projected, the largest of which is the light reflected from the anticathode, and the other is the light from the filament. One of these lights always serves as a guide. When a radiograph is to be made, the filament is lighted. Notice

where the light falls upon the body and mark the spot with a pencil. By so doing, duplicate radiographs can be made. This method is easy and practical. Experience will tell the radiologist if the shadow should be higher or lower, a matter of adjusting the tube.

Respiratory Immobility.—It is difficult to make some patients hold their breath, or to get radiographs of them either during expiration or inspiration: they always do the opposite to what they are told.

The method here described gives me good results. The spring is taken out of a clothespin and replaced by paste, because the metal is strong and produces pain. When one desires to make a radiograph of the lung or gall bladder, and it is essential that the patient shall not breathe, the clothespin is placed on his nose so that he may not breathe through his nostrils, and he is ordered to breathe through his mouth. When one wishes him to stop breathing, he is ordered to close his mouth. If a film is to be taken after inspiration, the patient is asked to take a deep breath and then close his mouth. The same method is employed for expiration. Thus the patient is not able to breathe or move the diaphragm because the nose is closed—that is usually what spoils a radiograph.

Impregnation of the Stomach Wall.—In my book printed in 1918, as well as in the *Semana Medica*, I have published the prescription for an opaque meal which is as follows: Barium sulphate, 60-90 grams; gum arabic, 5-10 grams; sugar, 15-20 grams; boiled eggs (whole), 2; milk, 200 cubic centimeters. By mixing these ingredients and shaking them, there is produced a good opaque meal, emulsified by the eggs, gum, and milk. The first dose is composed of two tablespoonfuls of this meal and 30 c.c. of sodium bicarbonate solution, and the second dose of twice this amount. The gas from the water becomes volatile, containing

anhydrous carbonic gas, on account of the warmth of the body, and makes the barium sulphate adhere to the stomach wall, by which means, I am able to obtain good radiographs.

X-RAY "DIAGNOSIS"

By R. W. A. SALMOND, M.D.
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Every now and again a radiologist is impressed by the fact that his findings are not confirmed at operation, and is puzzled because the opinion he offered seemed quite straightforward. What is even more disconcerting is the feeling that he would be justified in expressing a similar opinion on a future case presenting similar appearances. An explanation is hard to give unless one falls back on the adage that radiology is an inexact science, or accepts the inevitable, taking comfort in the fact that mistakes become less frequent as experience increases.

Recently a stomach which had had a gastro-enterostomy done four years previously was examined by one radiologist and no sign of any stoma was observed. A few months later the writer independently made the same observation, that there was no evidence of any stoma acting. As the patient had some obstructive symptoms operation was performed, and the surgeon reported that the stoma was quite patent and he could pass two fingers through it. There was also no sign of any ulcer in its neighborhood to cause spasm.

Another example was a dental case which showed on the film all the appearances of an abscess or granuloma (not the mental foramen) at the apex of one of the lower canines, with the surrounding alveolus showing a normal appearance. The tooth was extracted but no abscess was found. As there was a granulating mass on the gum immediately posterior to the canine, a piece of this was also removed and found to be a myeloma. One ought to say in the latter

case that the surgeon had suspected a myeloma on clinical grounds.

Cases such as these must have occurred in the practice of every radiologist, and point to the moral that, in countries where the radiologist usually confines himself to radiology, his opinion is only one of the spokes (though usually a valuable one) in the wheel of diagnosis of a case, and it is salutary for him to realize that, no matter how carefully his work has been performed, his findings may not always be confirmed at operation or by other means.

DIVERTICULUM OF THE DUODENUM

CASE REPORT

By JOSEPH H. LUCINIAN, M.D., MIAMI, FLORIDA

Diverticula of the gastro-intestinal tract are not rare: cases have been reported of diverticula in the esophagus, stomach, duodenum, jejunum, ileum, and the large intestine. They may be single or multiple, and are less frequent in the upper tract than in the lower. The following case is reported not only because of the unusual size of the duodenal diverticulum, but also because of the difficulty of differential diagnosis.

REPORT OF CASE

J. I. B., a married, white woman, aged 40, was referred to me on July 26, 1930, by Dr. W. A. Haggard, for roentgen examination of the gall bladder and gastro-intestinal tract. Her past history revealed nothing significant, except for influenza and pneumonia, and an appendectomy fifteen years previously. There had been no loss of weight. The marital history was irrelevant; no pregnancies. The present history dates back two to three years, at which time the patient began having distress after taking acid fruits



Fig. 1. Film made in the prone position, showing a large duodenal diverticulum, apparently connected with the bulb and pylorus. Normal ascending duodenum lateral to diverticular sac.

and such foods as pickles and tomatoes. Pain would commence as soon as food was swallowed, gradually diminishing in severity and finally disappearing in two or three hours. However, immediately on taking more food, pain would return. Milk had no influence on the pain, but soda and milk of magnesia at times would relieve it completely for a short period. There was no pain at night. Rarely the patient vomited. At one time there had been bile in the vomitus, but never blood or coffee-ground material. Two months previously, the patient had eaten turnip greens for supper, and the next morning vomited the whole in an undigested state. At times there was a burning sensation in the epigastrium to the right of the midline, but chiefly after taking acid foods. Occasionally, pain would strike in

the region of the right scapula. There was no history of gallstone colic. The patient's appetite was poor; she was never constipated; her habits were regular. There was no history of blood or mucus in the stools.

On physical examination the patient was found to be well nourished and well developed. On fluoroscopic examination both lungs were seen to be well aerated; the heart, thoracic vessels, the diaphragm, and the posterior mediastinum showed nothing remarkable. The esophagus was smooth and showed no delay. The stomach was of the modified fish-hook type, hypertonic, showing active peristalsis and hypermotility. It was completely empty in about two hours. The pylorus and duodenal bulb were smooth and regular. There was no tenderness on deep palpation, either in the stomach or the duodenum, but in the space just above the pylorus and lateral to the duodenal bulb, there was exquisite tenderness.

The patient was next examined in the supine position and the area under suspicion explored fluoroscopically, with negative findings. She was then placed prone in the right oblique position, with the head of the table lowered. Immediately a large pouch was seen just above the pylorus. The stomach emptied so rapidly that it was impossible to distinguish this sac from the bulb, the third portion of the duodenum, or the pyloric end. This large sac closely simulated a dilated loop of the duodenum, but close observation showed that just behind it, the opaque meal was emptying rapidly through another loop into the jejunum. The next point to be considered was whether the sac was connected to the cap or the pylorus. By turning the patient in various directions, it was proved to my satisfaction that the sac had no connection with either, but had a direct connection by a narrow stalk with the ascending portion of the duodenum, proximal to the ligament of Treitz. Now that the sac was filled, the patient was turned on her

back and the area of tenderness was found to correspond exactly with the anomalous sac. She was again placed in the erect position and an attempt made to visualize the pouch. It was emptied and the barium could not be forced into it by manual effort. The duodenum and the sac were completely empty at the same time as the stomach. In the horizontal position it was again demonstrated beautifully. In its transverse diameter it was about two and one-half centimeters wide and in the longitudinal, about three centimeters long. The remainder of the gastro-intestinal tract showed no evidence of diverticula. The gall bladder was slow in emptying. A roentgen diagnosis of large duodenal diverticulum was made.

The patient was operated on four days later. The sac was located with some difficulty, posterior to the stomach. Resection was time-consuming and difficult, because of numerous adhesions. The gall bladder was palpated and no stones felt. The patient did not recover from the operative shock, and died in fifteen hours.

COMMENT

Several interesting features stand out in connection with this case, which should prove instructive. The history of epigastric pain, referred to the right shoulder, was suggestive of gall-bladder disease, with probable gallstone formation. The pain coming on immediately after the taking of acid foods was suggestive of gastric, rather than duodenal, ulcer. In a previous paper (1) I emphasized the fact that duodenal diverticula may simulate gastric, duodenal, or gall-bladder disease. Frequently the symptoms and signs are obscure rather than clear-cut and definite. It is in this type of history that we should be on the lookout for such unusual lesions. It is well said that the critical area of the abdomen is situated where "the head of the pancreas lies in the arms of

the duodenum." Often a systematic search of this area will amply reward the roentgenologist for his efforts, by revealing to him the true cause of many indefinite symptoms.

Differential Diagnosis.—Enlarged or dilated loops of the duodenum should not be confused with a true diverticulum. The former will usually show peristalsis and a serrated outline, normal in this part of the intestine, which is absent or indistinguishable in diverticula. Reversed or retrograde peristalsis may be seen. Diverticula of the stomach are less frequent, but should be borne in mind. A large, accessory pocket of an ulcer, either of the stomach or duodenum, usually has a smooth outline and occasionally the barium is capped in it by a bubble of gas. Perforated gastric ulcer may produce a sac of varying size, the barium entering through the perforation and simulating a diverticulum. Less frequently, dense, visible gallstones may be confused with a diverticulum. Needless to say, loops of the duodenum may be distinguished by the valvulae conniventes, which are absent in diverticula.

Traction diverticula are commonest near the pylorus, are usually secondary to ulcers, and are composed of all three layers of the intestinal wall. In the pulsion type the wall is made up of the mucous layer only. These are more common near the duodeno-jejunal juncture and the papilla of Vater.

Diverticulitis or peridiverticulitis may supervene, in which case nausea, vomiting, local tenderness, and increased pain characterize the complication.

SUMMARY

1. A case of an unusually large duodenal diverticulum is presented, offering difficulty in clinical and roentgenologic diagnosis.

2. The symptoms consisted of a slight and indefinite epigastric discomfort and pain



Fig. 2. Film made in the standing position, showing failure of the diverticulum to fill with barium.

following the taking of acid food, of two to three years' duration.

3. A history of chronic digestive disturbance or vague and unexplained digestive symptoms of long standing should arouse our suspicion and should be thoroughly investigated for duodenal diverticulum.

4. It is the common practice in many large institutions to do fluoroscopy in the vertical position only. More recently many internists have been induced to install fluoroscopes, practically all of the vertical type, with which to make cursory examinations of the stomach and duodenum.

5. The diverticulum in the case herewith presented eluded all efforts at visualization in the standing position, but was readily visualized in the horizontal position.

6. Unless a combined vertical and horizontal fluoroscopic examination is carried

out, it can readily be seen that not a few of these obscure cases will remain undiagnosed.

REFERENCE

- (1) LUCINIAN, JOSEPH H.: Diverticulum of the Duodenum Perforated into the Pancreas. *Am. Jour. Roentgenol. and Rad. Ther.*, December, 1930, XXIV, 684, 685.

A PROBABLE CASE OF GAUCHER'S ANEMIA

CASE REPORT

By W. S. MUIR, B.A., M.B. (Tor.), and
L. R. LINGEMAN, M.D.

From the Out-patient and Radiological Departments
of the Rochester General Hospital
ROCHESTER, N. Y.

Chief Complaint.—Pain in the left hip region when stepping up or down.

Family History.—Irrelevant.

Past History.—Childhood uneventful. At 15 years of age the patient had an osteomyelitis of the left tibia, which was operated on and which healed promptly. She enjoyed good health until she was 22 years of age. At that time she fell downstairs, striking her right thigh, but was able to get

up and walk. A few days later, while lying on the beach, she turned quickly and fractured her right femur at the junction of the middle and lower thirds. At that time a diagnosis, on the basis of an X-ray examination, was made of a pathologic fracture due to osteitis fibrosa cystica. The fracture was treated in the usual manner and bony healing resulted. During the following winter the patient received some X-ray treatment over the region of the fracture. She enjoyed good health until February, 1930, when she began to complain of pain in the left hip joint region when going up and down stairs or when she remained seated in one position for any length of time. She entered the Out-patient Clinic in April, 1930.

Physical Examination.—At that time the patient appeared to be a well nourished, fairly well developed, Jewish female 25 years of age. Her skin was dark; head and neck were normal; the thyroid was not enlarged; a systolic murmur was heard in the aortic area and along the left border of the



Fig. 1. The femora, antero-posterior view. Note the erosion of the cortex from the inside.



Fig. 2. The right femur shows a healed fracture. Note the expansion of the lower portion of the diaphysis, and the infiltration.

sternum; the pulse was regular; the blood pressure was 126/80; the upper border of the liver was at the level of the fourth rib anteriorly; the lower border reached 7 cm. below the costal margin in the mid-clavicular line; the spleen was enlarged and extended 7 cm. below the costal margin. There was an old healed scar over the left tibia, and a definite limitation of motion of the left hip in all directions.

Laboratory Findings.—Urine, specific gravity 1.025; albumin, negative; sugar, negative; urobilin, trace. Blood: red blood corpuscles 3,140,000; white blood corpuscles 4,500; hemoglobin, 70 per cent; neutrophils, 63 per cent; lymphocytes, 35 per cent; Wassermann reaction, negative.

At the time of admission a survey was made of the entire skeleton and it was noted that the cortex of all the bones was thin, this being particularly true of the bones of the vault. In addition, a pathologic condition was seen to involve several of the long bones. This change was most extensive in the femora. It began at the level of the lesser trochanter and extended downward to the condyles. The lower thirds of the femoral shafts were expanded. The cortex appeared to be eroded from the inside in the upper portion, while in the lower third the lamella of the bone seemed to be infiltrated and separated, in addition to the erosion. The lower third of the right femur was the seat of a healed fracture.

The head of the left femur was mottled and almost suggested fragmentation. The left tibia, the seat of the osteomyelitis at 15, was bowed inwards and showed some loss of density of the medulla. Several small areas of lessened density were seen in the upper end of the right humerus and one small punched-out area was seen in the upper end of the right radius.

On the basis of the physical examination and the roentgenologic appearance of the bones a diagnosis of Gaucher's anemia was



Fig. 3. Right femur, lateral view, showing the area of destruction in the region of the fracture.

made. The patient refused permission for a biopsy.

On the basis of the result obtained by Sosman (1) with radiation, the spleen and long bones were radiated, with the follow-

ing factors: K.V. 190; ma. 20; filters 0.5 mm. Cu and 2 mm. Al; distance 50 centimeters. The individual treatments were as follows:

5-21-30. Spleen (posterior), 12 minutes.

5-23-30. Spleen (anterior), 12 minutes.

5-23-30. Femora (anterior), including hip joints, 12 minutes.

5-27-30. Tibiæ (anterior), 12 minutes.

5-28-30. Humeri (anterior), 12 minutes.

6-4-30. Spleen (lateral), 10 minutes.

6-13-30. Spleen (anterior and posterior), 8 minutes each.

6-17-30. Femora (anterior), including hip joints, 12 minutes.

7-17-30. Femora (posterior), including hip joints, 12 minutes.

7-17-30. Spleen (anterior), 6 minutes.

7-18-30. Tibiæ (anterior) and humeri (anterior), 12 minutes each.

The patient obtained some relief from the pain and limitation of motion in the left hip, but her hemoglobin dropped so low that radiation was discontinued. The spleen and liver did not decrease in size. The entire skeleton was re-surveyed six months after suspension of the treatment and no changes were noted in the bones.

Immediately after discovering high blood cholesterol the patient was restricted to a low fat diet. Subsequent observations showed a fall in blood cholesterol, but since cholesterol metabolism is complicated and the blood cholesterol normally undergoes marked variations, no estimate of the effect of low fat diet can be made without observation over a much longer period of time. Continuance of such dietary restrictions seems warranted, as Gaucher's disease, one

of the xanthomas, since the work of Panzer (3), 1906, and Pinkus and Rich (2), 1908, has been considered a manifestation of disturbed lipid metabolism.

During the course of observation the following laboratory work was recorded:

5-8-30. Gastric test meal, 1 oz. of stomach residue: free HCl 34 c.c. N/10 NaOH; total acidity 54 c.c. N/10 NaOH; no blood.

7-18-30. Cholesterol (plasma), 190 mg. per cent.

9-30-30. Basal metabolic rate 16 per cent blood sugar fasting, 114 mg. per cent. Cholesterol (whole blood), 290 mg. per cent; calcium (serum), 11 mg. per cent; phosphorus (serum), 3.8 mg. per cent.

11-20-30. Cholesterol (whole blood), 255 mg. per cent.

1-8-31. Cholesterol (plasma), 185 mg. per cent.

3-4-31. Cholesterol (whole blood), 190 mg. per cent.

4-28-31. Calcium content of urine, 0.06 gm. (expressed as calcium oxide) per 24-hour specimen.

5-20-31. Cholesterol (whole blood), 255 mg. per cent; serum calcium, 13 mg. per cent.

There has been little change in the patient's condition during this time. The general feeling of weakness and fatigue continues. She has experienced definite relief from the pain in her left hip and is able to sit for a greater length of time and change position with less discomfort. Neither the liver nor spleen has changed in size.

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EDITORIAL

LEON J. MENVILLE, M.D. . . . Editor
BUNDY ALLEN, M.D. . . . Associate Editor

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RADIATION THERAPY

Radiation therapy has become so tremendously important that it is now recognized by eminent medical authorities as an indispensable factor in the modern treatment of cancer. Its progress in recent years has been so rapid and effective that only a bold prophet would predict its future development. This has been the result, in no small degree, of the indefatigable workers in radiological research, who have standardized its application with almost mathematical accuracy, so that it has become a dependable and highly efficient form of treatment.

The American Association for Cancer Research and the American Society for the Control of Cancer have approved and recommended the use of radiation therapy in the treatment of cancer. In spite of these splendid endorsements and its universal use, there are some physicians and surgeons who would ignore its value.

A perusal of the current medical literature appertaining to the use of radiant energy in the treatment of precancerous and cancerous lesions reveals that some authors are somewhat reluctant to acknowledge the important position it occupies at the present time, when discussing the treatment of cancer. Their attitude in this regard can be construed to mean that, in their opinion, radiation therapy has been overrated and is fast becoming obsolescent. Or, we may be-

lieve that theirs is but another case of not being able to see the woods for the trees.

It is not difficult for an unprejudiced mind to ascertain from the literature the many notable accomplishments of radiation therapy in the treatment of malignancy. In order to thrive, plants need the stimulating influence of sunshine, and, in a like manner, physicians often need the stimulating influence of good literature if they are to progress and become successful in the practice of medicine. Those in search of the beneficial effect of medical knowledge will find in RADIOLOGY many interesting and educational articles on radiation therapy, and such literature will prove especially advantageous to those who manifest an indifferent attitude toward this form of treatment.

It is only necessary to cite a few of the many instructive articles on this subject which have appeared in the issues of RADIOLOGY, all of which will stand as substantial proof of the brilliant results obtained by radiation therapy. In the February issue of RADIOLOGY, which was dedicated to Dr. Joseph Colt Bloodgood, in recognition of his brilliant work on cancer, will be found numerous articles on the X-ray diagnosis of bone tumors and also an excellent editorial on "Working Rules for Lesions of Bone," by Dr. Charles F. Geschickter of the Garvan Research Laboratory, Johns Hopkins University and Hospital. This is but one example of the recognition of the value of the X-ray and radium in the diagnosis and treatment of cancer by eminent authorities who are not radiologists. While this splendid contribution is largely diagnostic, very important information may be obtained in regard to radiation therapy. The interesting editorial on "Imposition on Radiation

Therapy," by Douglas Quick, of New York City, which was published in the September, 1930, issue, is another example of the type of article appearing in RADIOLOGY. The numerous illuminating contributions on radiation therapy by Dr. Francis Carter Wood and Dr. George E. Pfahler deserve special commendation. Also, the splendid and enlightening articles on the same subject by Arthur W. Erskine, of Cedar Rapids, Iowa; Albert Soiland, of Los Angeles; Edwin C. Ernst, of St. Louis; Arthur U. Desjardins and Harry H. Bowing, of the Mayo Clinic; Dr. Edith H. Quimby and Dr. G. Failla, of the Memorial Hospital, New York City; Dr. L. S. Taylor, of the Bureau of Standards, Washington, D. C., and many others equally as prominent, are all outstanding accomplishments in this particular field of medicine.

In the successful treatment of any disease, it is imperative for the physician to have a thorough knowledge of its pathology. This information will be the guiding factor in the selection of the kind of treatment to be employed, a fact which is particularly true in cancer therapy, where the form of treatment will depend largely upon the type of malignancy. For instance, whether it is radiosensitive when X-ray or radium, or both, are used, or whether it is of a different type, will decide if the treatment is to be surgical, or if the best results are to be obtained by the combined use of X-rays, radium, and surgery.

We should exercise every precaution in choosing the correct form of treatment in cancer cases, and by no means should we permit ourselves to be prejudiced in favor of the specialty we practise and ignore that which experience has proven to be the one of probable benefit to the patient. It must not be forgotten that the physician's first duty is always to the patient, regardless of any pet notions he may have for or against any particular method of treatment.

There can be no denial of the fact that

certain cancer patients are treated by surgery who would have received greater benefit if radiation therapy had also been employed, and likewise, radiologists at times treat certain malignancies that could have been treated better surgically.

What is needed at the present time is a better understanding of the indications and limitations of the use of the X-ray, radium, and surgery in the treatment of cancer, and too much emphasis cannot be laid on the importance of a thorough knowledge of its pathology by the radiation therapist and surgeon.

This dissertation must not be construed as a defense of the use of radiation therapy, as it needs no defense, but only praise. Its purpose, however, is to make known the fact that there are practising physicians in these days of scientific medicine who show a disinclination to acknowledge the value of this agency. I want to press home to them the thought with all the earnestness of which I am capable, that radiation therapy and surgery have been instrumental in creating a spirit of optimism, which is the finest thought the human mind can cherish in regard to the treatment of cancer.

THE ANNUAL MEETING

ST. LOUIS, OL' MAN RIVER, AND THE SEVENTEENTH ANNUAL MEETING OF OUR SOCIETY

On November 30, 1931, the medical profession of St. Louis will welcome the Radiological Society of North America to spend a week on the banks of Ol' Man River, to enjoy the unbounded hospitality of the famous New Hotel Jefferson, and to visit and take advantage of the medical facilities of this miracle city, so rich and glorious in the romantic development of the history of medicine and surgery, as well as radiology.

The new St. Louis, a rich, modern me-



The New Jefferson Hotel, St. Louis, where the Seventeenth Annual Meeting of the Radiological Society of North America will meet November 30 to December 4, 1931.

tropolis, as well as the capital of commerce and industry in the Middle West, is privileged to be your host.

It was on the evening of February 14, 1764, that a little band of French pioneers first landed on the west bank of the Mississippi River, at what is now the foot of Walnut Street in St. Louis. For many days, patiently fighting the current, they had poled and dragged their heavy craft up the great river from Fort de Chartres, sixty miles below. Wearing by their labors, they slept that night on their boat.

Like the landing of the Pilgrim Fathers, the coming of this "First Thirty," as they became known in colonial days, proved a milestone which marked the beginning of an empire. For when, on the following morn-

ing, August Chouteau lead his men across the sandy beach and up the plateau overlooking the river, pointing out to them there a line of blazed trees, the ringing blows of axes soon sounded through the woods, and the building of St. Louis began. Then and there was born the spirit of a community.

The previous year a far-sighted engineer named Laclede had conceived the idea of a permanent settlement in some favorable river location. Searching for the ideal spot, he, accompanied by August Chouteau, explored the Mississippi north and south, and, as the still preserved record relates, "he fixed upon this place, marked with his own hands some trees, and said to Chouteau, 'You will come here as soon as navigation opens, and form a settlement after the plan



The Lobby, New Hotel Jefferson, St. Louis, where members of the Radiological Society of North America will gather during the week of November 30 to December 4, 1931.

which I shall give you. For here may well develop one of the finest cities in America, since here are such unusual advantages of location and of central geographical position!"

Those were indeed pioneer days, days when the European powers, England, France, and Spain, contended for a continent. At that time neither cities nor towns existed in all the silent wilderness of the Mississippi Valley. Here and there, hundreds of miles apart, roughly stockaded and scantily garrisoned forts constituted the only outposts of civilization, the sole refuge against Indian attacks. Frontier lines there

were none. Life in the New World was a continual struggle for existence.

Other expeditions, French and Spanish, soon sought to overshadow the little settlement of St. Louis. A Spanish fort was built a short distance to the north. Yet so well had Laclede chosen, and so energetically had his followers labored, that these competitive efforts gradually merged with St. Louis itself. Within three years its colonists, by sheer force of spirit, had established valuable fur-trading monopolies with the twenty-eight principal Indian nations, including not only those west of the Mississippi, but also those east of the river and even

as far north as the Great Lakes. These the English tried in vain for many years to break.

Within five years the fur trade of St. Louis had grown to the amount of \$80,000 annually, a great sum in those days. That trade was the commercial cornerstone, the basis of prosperity. Every year thereafter saw the city's radius of influence lengthen. Up the Mississippi and Missouri crept a line of outposts. St. Louis became the gateway of the stream of migration, the starting point of expeditions in all directions. Some of these were military, establishing forts; some scientific, to explore and exploit; more were to establish communities, to open commercial avenues. The Lewis and Clark Expedition in 1804, opening the Northwest, was one of these. So, too, the Frenchmen of St. Louis paved the way for the American occupation of Louisiana. A branch of the Chouteaus started Kansas City; Robidoux, of St. Louis, established St. Joseph; one of the Menards founded Galveston. A hundred Western cities and towns owe their beginning to St. Louisans.

With the "Louisiana Purchase" in 1803, all that vast stretch of territory which is now the central and western part of this country came into national possession, more than doubling the area of the United States. Meanwhile, St. Louis has steadily grown. Seven years after its incorporation as a city in 1823, its population was 4,977, ranking forty-fourth among American cities. In 1833 it was in twentieth position and growing fast.

Missouri became a State in 1821, and, in time, became the central State of all the Union. Two States away, to the south, today lies the Gulf of Mexico; two States north is the Canadian line; five States east is the Atlantic; five States west, the Pacific. Thus, Missouri, and St. Louis, its chief city, is the geographical heart of the Union, the very center of its life and activities.

The year 1811 marked the appearance of the Mississippi steamboat. Five years later the first steamboat came up the river to St. Louis. For half a century thereafter the river trade grew by leaps and bounds. Just prior to the Civil War this river traffic was at its height. Hundreds of the old-time steamers, their decks piled high with cotton, daily ploughed the Mississippi. The steady, chugging beat of their paddles and the hoarse boom of their giant whistles awoke the echoes throughout the valley. Millions of dollars were invested in the river fleet. St. Louis was at that time the leading city in the West.

On the borderland between North and South, Missouri suffered cruelly from the Civil War, more than one-tenth its battles being fought upon Missouri soil. The great current of traffic, which up to that time had flowed north and south, was abruptly broken. The tides of trade turned east and west, served by rails instead of rivers. During the reconstruction period St. Louis temporarily lagged, yet it soon caught the cadence of the shriller whistles and moved on, losing but one rank in the procession of American cities. And to-day, the sixth largest manufacturing city, St. Louis, with its nineteen trunk lines operating thirty lines of railroad, has become America's second greatest railroad center, with a reborn river traffic greater than was ever dreamed possible, and with developing possibilities which only the most farsighted can conceive.

St. Louis has many unique advantages not afforded other cities. Situated as it is, it is the most easily accessible city in the United States. The Terminal Railroad Association of St. Louis has the largest unified freight and passenger terminals in the world. It owns and operates the great St. Louis Union Station by which all passenger trains enter and leave the city. It has more than 400 miles of track, handles 4,660,000 freight cars and 650,000 passenger cars an-

nually, serving 1,500 industries direct from its own tracks. It operates six belt lines, 175 switching engines, and has interchange connections with 27 railroads at more than fifty different points, thus utilizing the combined car supply of all these sources and insuring St. Louis shippers a maximum of facilities at all times.

Because the Mississippi River has played such a significant part in the history of our city, it is perhaps one of the first things that the visitor wishes to see. With its tugs and steamboats, its barges and tows, its pleasure craft, its ferry boats and mighty bridges, all flanked by the elevated railroad and the skyscrapers of the nearby business district, it presents an unforgettable picture. The old section of St. Louis adjacent to the river, still interesting, forms the district referred to by Charles Dickens in his "American Notes" as the "French Quarter."

St. Louis is at the center of the Mississippi River inland waterways system, the largest inland waterways in the world. This river system consists of a series of navigable rivers and canals having a total of 13,394.42 miles, which is more than any single railroad system in this country.

The Mississippi River system connects by water 29 of the principal industrial cities of 20 States in the Mississippi Valley, with a total population of 11,000,000, and affects by joint river and rail rates a population of more than 50,000,000.

Not all of these facts are pertinent interest to radiologists, yet, since all radiologists are citizens and many of them men of affairs, the facts here set forth are sure to be of interest to certain of our readers. It is well for all to know the importance of the city to which we will be going as guests during the week of the Annual Meeting.

IMPORTANT RAILROAD INFORMATION

ONLY 100 CERTIFICATES NECESSARY
The Chairman of the Central Passenger

Association on September 9, 1931, wrote as follows:

"We have pleasure in advising that Central Passenger Association carriers have reduced the minimum number of certificates required under the Certificate Plan regulations from 150 to 100, that is, if there is a total of 100 authorized certificates presented at your meeting, they will be validated by the Railway Special Agent.

"No change has been made in the last date on which validated certificates *must* be presented to ticket agents for purchase of return tickets at one-half fare, namely, December 8, 1931.

"Tickets so purchased, however, will be good for return passage to reach original starting point *within 30 days* in addition to date of sale of going ticket—*via* same route as used on the going journey."

This is a definite gain *in time* for the trip to our St. Louis meeting, besides a reduction in number of certificates necessary to secure the reduced rate.

I. S. TROSTLER, M.D.,
Manager of Transportation.

IN MEMORIAM

VICTOR W. MAXWELL, M.D.

The death of Dr. Victor Wiley Maxwell, at Gulfport, Mississippi, on June 26, 1931, was a shock to his many friends in both Mississippi and Louisiana. Dr. Maxwell was forty years of age. He was graduated from the Tulane School of Medicine in 1915. After a few years of general practice, he specialized in radiology, opening an office at Jackson, Mississippi, where he successfully practised his chosen specialty. His ability, his personality, and his professional attainments make his death a real loss to the Radiological Society of North America, to the community in which he practised, and to the friends who deplore his passing.

ELMORE CALLAWAY THRASH, M.D.

Elmore C. Thrash, M.D., of Atlanta, Georgia, a prominent internist with a strong leaning toward radiology, died suddenly on June 22, 1931.

Dr. Thrash was born at Gay, Georgia, February 20, 1867, and attended Gordon Institute at Barnesville, Georgia, after which he taught school for a few years. He was graduated from the School of Medicine of the University of Louisville in 1891. After serving an internship at Louisville City Hospital, he entered practice in his native town. After a few years he moved to Atlanta, where he continued in active practice until his death.

He was keenly interested in medical politics and served his fellow-physicians in numerous capacities in local, state, and national medical organizations, where his presence and counsel were always felt for the public and professional good. For the last five years he was a delegate to the American Medical Association from Georgia, last year being appointed on the Committee on Publications and the Committee on Medical History. Other medical offices held were Counsellor for the Medical Association of Georgia, Past-president of the Chattahoochee Valley Medical and Surgical Association, Fulton County Medical Society, Medical Association of Georgia (1921-1922).

He had been Professor of Pathology and Bacteriology at the Atlanta School of Medicine, 1905-1914; Professor of Diseases of the Chest, 1914-1917, and was on the staffs of Grady, Piedmont, St. Joseph's, and Georgia Baptist Hospitals.

He was a member of Phi Chi, the Southern Medical Association, the Chattahoochee Valley Medical Society, the Fulton County Medical Society, the Medical Association of Georgia, the Radiological Society of North America, a Fellow of the American Medical Association and of the American College of Physicians. The various Masonic bodies

and the Mystic Shrine knew him as a frequent and active worker. He was a devout member of the Ponce de Leon Baptist Church of Atlanta.

Medicine has lost an earnest and conscientious advocate of the suppression of quackery, imposture, and ignorance, as well as a cultured, progressive, and sane advisor, in the passing of this highly respected Southern physician.

I. S. TROSTLER, M.D.

COMMUNICATIONS

THE PARIS CONGRESS

The Third International Congress of Radiology has passed into history. To describe in detail a chronicle of events during that week would be a task even for the finished columnist, so the writer will essay only a few personal glimpses, as memory may serve.

In the first place the expected hot weather of a Paris in July was graciously absent; in fact, the climatic conditions were ideal. The arrangements for the scientific and commercial program were as nearly perfect as conditions would permit, the Sorbonne serving admirably as a general center for everything except the exhibits, which were at a considerable distance but well worth any time or energy one could accord them.

It becomes necessary to dwell a little upon the social program which was executed upon such a scale as to make one gasp in astonishment. Luncheons, dinners, banquets, receptions, and soirées were upon a scale of splendor and lavishness that would challenge the thoughts of a world-wide financial crisis. This elaborate entertainment program was tendered by the French to their foreign visitors with an open-hearted generosity quite touching in its sincerity.

Irrespective of how much visitors appreciate and enjoy such splendid festivities, it

is apparent that a reasonable limit to such entertainment must be established, or there is danger of the scientific aims and attainments of the world's congress assuming a secondary position. The writer ventures to suggest that in future congresses the major entertainment features be postponed until after the conclusion of the scientific program.

Now as to the business of the Congress. Representatives of twenty-six nations had signified their intention to attend—twenty-three actually answered roll call, with a total registration of over fifteen hundred delegates. This, under present conditions of financial stress, is a remarkable showing and demonstrates beyond the shadow of a doubt the importance of radiology to the scientific world. It was a distinct disappointment to all, including the French nation, that Germany responded with only five delegates. The one hundred or more German physicians, many of whom had entered valuable scientific contributions, were unable to leave Germany because, due to an official government edict arising from an acute financial crisis, they were unable to withdraw sufficient funds from their banks to cover their travelling expenses.

As already established by the Congress, the three official languages—English, French, and German—were in evidence, although a number of the Italian delegates presented subjects in their own tongue.

More than four hundred individual contributions had been accepted by the French officials with a time limit of ten minutes placed upon each essayist. This, in the writer's humble opinion, is not just, as an essayist who prepares something worthy of presentation before a world's congress should be allowed at least twenty minutes, and it would be far better to limit the number of contributions. While it is true that a great many of the subjects offered were well worthy of a world's congress,

there was some duplication of effort, due perhaps to lack of co-ordination between the central office in France and the attending nations. The American delegates were informed early by the French authorities that scientific contributions could be listed by radiologists at large directly with the Secretariat at Paris. This made it impossible for the American delegates to check over all the papers, and it is assumed that similar conditions existed in some of the other large nations. These remarks are not intended as a criticism for it is doubtful if any governmental body could have served twenty-three nations better, or as well, as our French colleagues, but merely to serve as constructive thoughts for future guidance.

While all the French delegates and officials were gracious hosts during the Congress, to that distinguished savant, our President, Dr. A. Bécère, all honor is due. He presided at all functions with a vigor and grace scarcely believable in a man of his years. He was ably assisted by his charming daughter, Miss Antoinette Bécère, and son, Dr. Claude Bécère. Also a word about the Secretary-General, Dr. René Ledoux-Lebard, a master in both the French and English languages, who was in constant demand by the non-French-speaking Americans and Englishmen. He fulfilled the post of an efficiency master. One outstanding event must not be omitted—the receptions by his Excellency M. Paul Doumer, the President of France, to the one hundred and fifteen official delegates at the Royal Palace. A gentleman well past middle age, suave, dignified, and forceful, he shook you by the hand, looked you in the eye, and you received your measure. He was "every inch a ruler," but proved a delightful, democratic host to the delegates.

THE 1934 CONGRESS

The American delegation presented a cordial invitation from the affiliated radiolog-

ical bodies in the United States to hold the Fourth International Congress in this country. Switzerland, Germany, and Italy presented similar invitations. The votes of the delegates awarded the Congress to Switzerland, with United States as second choice. Professor Schinz, of Zurich, was unanimously elected President. The majority of the delegates expressed their preference for the United States, but stated frankly that they had not the means with which to make the journey to America in 1934. One thing was firmly established at the Congress—the friendship of the scientific world for the United States of America.

ALBERT SOILAND, M.D.

Representative of the American Medical Association and Chairman of Delegation from the United States.

PRESENTATION OF THE GAVEL
FROM THE AMERICAN RADIOLOGICAL SOCIETIES TO
THE INTERNATIONAL
CONGRESS ON RADIOLOGY

PARIS, JULY 27, 1931

MR. PRESIDENT:

I am commissioned to bring to you greetings from the radiological societies of America, namely, the American Roentgen Ray Society, the Radiological Society of North America, the American Radium Society, the American College of Radiology, and the Radiological Section of the American Medical Association.

They have sent a gavel as an emblem of authority to you and your successors, as an expression of our spirit of co-operation.

This gavel has been made from ancient ivory that was buried in the glaciers of Alaska during the glacial period and is,

therefore, estimated by some to be about a million years old.

We hope that this gavel may pass from president to president during at least a hundred years, and serve as an emblem of peaceful authority at our international meetings.

GEORGE E. PFAHLER, M.D.

ANNOUNCEMENTS

THE SUBJECT INDEX

The Editor announces that he has in preparation a subject index covering all the original papers and abstracts published in RADIOLOGY since the first issue. This will, it is anticipated, be of material assistance to all readers of the Journal, and will fill a real need.

It is impossible to say just when the index will be issued, but the work is being pushed forward to the utmost.

MEMBERS OF THE SOCIETY HONORED

Lyell C. Kinney, M.D., of San Diego, California, and Orville N. Meland, M.D., of Los Angeles, have been appointed recently on the Cancer Commission of the California State Medical Society.

SCIENTIFIC EXHIBIT

There is still space available for those who desire to participate in the scientific exhibit for the Saint Louis meeting of the Radiological Society. All those planning to make application are urged to do so as soon as possible, since it is the desire of the committee to allot the space October 21.

P. F. TITTERINGTON, Chairman
Scientific Exhibits Committee.

BOOK REVIEWS

CUTANEOUS X-RAY AND RADIUM THERAPY. By HENRY H. HAZEN, M.D., Professor of Dermatology, Medical Department of Georgetown University; Professor of Dermatology, Medical Department of Howard University; member of American Dermatological Association, American Roentgen Ray Society. Published by The C. V. Mosby Company, St. Louis, Missouri, 1931. Cloth, 166 pages, with 28 illustrations. Price, \$3.00.

This short practical book outlines the theory and technic of the X-ray and radium treatment of diseases of the skin, gives advice about the actual procedures, and warns against the commonest pitfalls. It rather seems that the actual irradiation of dermatologic lesions (covered in 68 pages), a procedure requiring scrupulous care and meticulous attention to detail to ensure satisfactory results, is dealt with rather sketchily. The book is an excellent introduction to the more complete works on the same subjects, such as those of Andrews and MacKee.

IODIZED OILS AS AN AID TO THE DIAGNOSIS OF LESIONS OF THE SPINAL CORD AND A CONTRIBUTION TO THE KNOWLEDGE OF ADHESIVE CIRCUMSCRIBED MENINGITIS. By MARTIN ODIN and GOSTA RUNSTROM in co-operation with ADOLF LINDBLOM. Published by Kungl. Boktryckeriet., P. A. Norstedt & Söner, Stockholm, 1929. With 4 figures in the text and 38 figures on 6 plates.

Because their experiments showed the ordinary iodized oils to be highly irritating to the meninges and their subarachnoid injection associated with clinical and serological evidence of meningitis, the authors con-

ducted experiments to determine the irritating ingredient of the oils and to produce a non-irritating, iodized oil. These experiments employed sesame oil, almond oil, soya oil, olive oil, and linseed oil. After these oils were iodized it was found that sesame and soya oil produced the least amount of irritation. The authors prefer the iodized sesame oil because it is thinner, lighter in color, clearer, and can be produced with a higher yield. They have developed a method for producing the oil which has reduced the meningeal irritation to a minimum.

The reaction following the injection of the iodized oils produced by the authors was much less than that arising after the injection of lipiodol and similar substances. In none of the cases where their own oils were injected in quantities of 4.5 to 5 c.c. was there any rise of temperature, headache, stiffness of neck, or evident Lasègue. After injection of greater quantities, up to 10 c.c., one or a few of these symptoms arose but were just as often absent, and when present they were very slight and transitory.

The authors report their observations in a series of twenty-four cases as follows: Tumors, 3 cases; inflammatory changes, 14 cases; syringomyelia, 1 case; disseminated sclerosis, 2 cases; cerebral tumor, 1 case; trauma, 3 cases.

The intralumbar method of injection is preferred and the authors' technic differs in that they use large amounts of oil, usually about 10 cubic centimeters. Only by using this amount of oil can small tumors and defects be observed. The passage of oil up and down the spinal canal is observed in the supine and prone positions in order that the anterior and posterior subarachnoid spaces may be seen. The authors are especially interested in the diagnosis of localized inflammatory conditions, and most of their cases are of this group. It is hoped that this valuable work will be supplemented with observations on a larger series of cases.

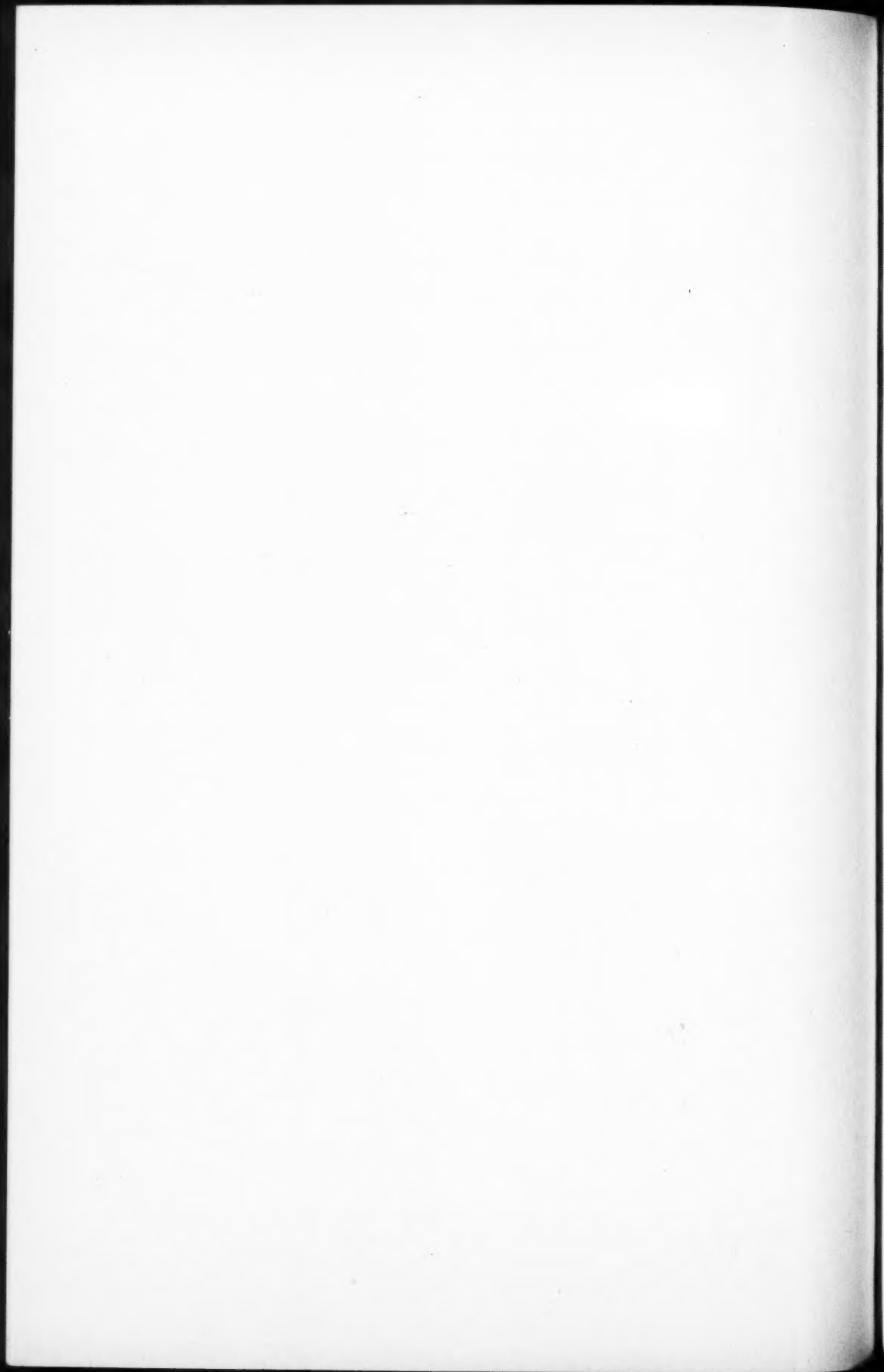
THE CHEST IN CHILDREN—ROENTGENOLOGICALLY CONSIDERED (Annals of Roentgenology, Vol. XII). By E. GORDON STOLOFF, M.D., Assistant in Pediatrics (Assistant Radiologist), Mt. Sinai Hospital; Adjunct Pediatrician, Beth Israel Hospital; Adjunct Pediatrician (Adjunct Radiologist), Sea View Hospital, New York. Foreword by BELA SCHICK, M.D., Pediatrician, Mt. Sinai Hospital, New York. Published by Paul B. Hoeber, Inc., New York, 1930. Pages, 432; illustrations, 406. Price, \$15.00.

In no phase of diagnostic roentgenology is an understanding of the clinical phenomena more essential to a proper interpretation of the roentgenographic changes than in diseases of the chest, and especially the child's chest. It is particularly fitting that Dr. Stoloff, who is an experienced pediatrician, equipped with a specialized knowledge of roentgenology as pertains to his specialty, should set forth his ideas concerning this subject. The continuous comparison of the clinical picture and course of a disease with the X-ray findings gives a valuable insight into pathologic physiology, and this knowl-

edge prevents many of the misleading and incorrect roentgenologic interpretations which are unfortunately often made by those whose judgment has not been tempered by the rebuffs of experience. It is the author's stated intention that in this work the roentgenology of the thorax in infancy and childhood shall be considered from the aspect of a clinician. Some radiologists may resent the trespassing of a clinician into their domain, but let them who would criticize reserve their judgment until after they have read this book.

Radiologists who have long desired an authentic text on the child's chest will be grateful for the information presented in this book. The subject-matter is concise and full of practical facts arranged in an orderly fashion that subsequent authors may well emulate. All progressive radiologists will enjoy and find much of value in this text. Students will find it indispensable, although for their use a more comprehensive consideration of the normal might have been in order.

The typography and illustrations are a credit to the high standard already created by the publisher.



ABSTRACTS OF CURRENT LITERATURE

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J. N. Ané, M.D.	F. B. Mandeville, M.D.
L. J. Carter, M.D.	L. Marinelli
F. Cavers, D.Sc., M.R.C.S.	H. C. Ochsner, M.D.
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Roe J. Maier, M.D.	V. Witting, M.D.

APPARATUS

Theoretical Aspects of Radiography
Warnford Moppett. Med. Jour. Australia.
 May 2, 1931, I, 521-523.

An experimental X-ray tube is briefly described in which a metal plate served the double purpose of target and tube wall. It was possible to place a lead cover pierced by a pin-hole over the target and thus secure a point source of X-rays. This pin-hole screening could have been done, of course, without the use of the author's special tube, and a point source of X-rays obtained from any ordinary X-ray tube by the mere use of a pierced lead screen (Huyghen's principle).

The author does not state the intensity of the radiation thus obtainable, and the paper, therefore, loses much interest.

The general optical principles involved in the production of shadow pictures are discussed.

J. G. STEPHENS, M.D.

The Resolving Power Attainable in X-ray Spectroscopy by Photographic Methods.
Samuel K. Allison. Phys. Rev., July 15,
1931, XXXVIII, 203-211. (Reprinted by
permission.)

If w_c , the (half) range of glancing angle over which a crystal will reflect monochromatic X-rays, has been determined by the double spectrometer method, it is possible to calculate what resolving power is attainable from this crystal by photographic methods. Equations are set up giving the resolving power in terms of a , the slit width, and R , the distance from slit to photographic plate.

Some results are as follows: (1) No appreciable increase in resolving power is attainable by making $a/2R < \frac{1}{4}w_c$; (2) if $a/2R > \frac{3}{4}w_c$, the resolving power does not involve w_c ; (3) the resolving power attainable in the first order is $1/2^{1/2}$ of that attainable in a double spectrometer with crystals of equal perfection. Equations are also derived by which observed line widths in photographic spectrometers may be corrected for slit and crystal dif-

fraction pattern effects. The results are applied to recent experimental results with photographic spectrometers, and it is shown that the width of $\text{MoK}\alpha_1$ observed photographically is considerably greater than the values obtained by the double spectrometer.

X-ray Absorption Coefficients of Mercury Vapor in the Region of its L-absorption Discontinuities. Fred M. Uber. *Phys. Rev.*, July 15, 1931, XXXVIII, 217-224. (Reprinted by permission.)

An apparatus is described which is suitable for absorption measurements up to two or more Ångströms. The absorber, which was in the form of superheated vapor the density of which could be calculated on the assumption of perfect gas behavior, was contained in an all-glass chamber. The windows were constructed of thin glass films in such a way as to withstand atmospheric pressure from either side. The mass absorption coefficients, μ/ρ , of mercury in the wave length region 0.74 to 1.4 Å. were determined by an ionization method. They were found to obey the relation $\mu/\rho = A\lambda^c$, where the constants A and c vary from branch to branch of the μ/ρ , λ curve. The value of c is 2.56 on the short and 2.66 on the long wave length side of the L -discontinuities. The magnitudes, δ , of the three L -absorption discontinuities, where δ is defined as the ratio of μ/ρ (the scattering coefficient being neglected) on the short and long wave length sides of an absorption limit, are $\delta_{L_I} = 1.18$, $\delta_{L_{II}} = 1.39$, $\delta_{L_{III}} = 2.45$.

Five Hundred Kilovolt Cathode Rays.
R. E. Vollrath. Phys. Rev., July 15, 1931,
XXXVIII, 212-216. (Reprinted by permis-
sion.)

The high potential X-ray tube at the California Institute has been modified so as to permit either X-rays or cathode rays to be produced. Electron currents up to 35 microamperes have been obtained through an aluminum window. A typical magnetic velocity

spectrum of the high speed electrons passing out of an aluminum window is presented. The high velocity limit corresponds to about 500 kilovolts when the transformer voltage is 600 kilovolts peak. The velocity spectrum appears to be continuous, and no absorption anomalies due to aluminum and lead foil are evident. The time required to obtain a velocity spectrum was reduced to a few minutes by allowing the electrons after being magnetically deflected, to pass through a copper foil into the air. The outside of the foil is coated with calcium tungstate, and the photographic plate is placed in contact with the tungstate. It is noted that part of the photographic action of the high speed electrons is due to fluorescence of the glass backing of the photographic plates.

BLOOD CHANGES

Transmission of Blood Changes Produced by Irradiation. J. Gouin, A. Bienvenue, P. Daoulas, and Pérès. *Bull. Soc. Radiol. méd. France*, 1929, XVII, 286-288. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 248.

The injection of the blood of a healthy person in whom a leukocytosis had been produced by a roentgen irradiation into a second unirradiated healthy individual produces the same blood changes in the untreated individual. A syphilitic always reacts by hyperleukocytosis. This appears to be a specific reaction of the syphilitic to irradiation.

H. C. OCHSNER, M.D.

Nuclear Variations in Various Pathologic Conditions and after Roentgen Irradiation. T. Saragea and V. Valter. *Bull. Soc. méd. Hôp. Bucarest*, 1929, XI, 249-252. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 248.

The basis of the study was Lions' observation on the nuclei of leukocytes during the periods of remission of disease processes. He noted an increase in nuclei proportionate to the decrease of the total leukocyte count. The

authors observed that, after massive doses of X-ray, there was a rapid increase in the number of nuclei and a proportionate diminution in leukocyte count. After small doses there was an increase in the nuclei, which undoubtedly explains the increased resistance of the patient.

H. C. OCHSNER, M.D.

Changes in Pigment following Irradiation. E. Kasatkin, A. Grubina, and S. Melbart. *Ter. Arch.*, VIII, 251-262; and *Deutsch. Zusammenfassung*, 1930, p. 262. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 581.

After irradiation of guinea pigs and humans with from 3.5 to 6 H.E.D., the authors have observed increased hemolysis and blood regeneration. The urobilin value was increased in the first three days after irradiation and remained the same for several days. If the number of reticulated cells increased, there was no diminution of hemoglobin or erythrocytes. The authors believe that the metabolic disturbances after irradiation are the sequence of increased hemolysis.

H. C. OCHSNER, M.D.

The Influence of Ultra-violet Irradiation on Blood Ferment. B. M. Koldajew and M. M. Altschuller. *Hoppe-Seyler's Ztschr.*, 1930, CLXXXVI, 223-228. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 252.

The authors studied the blood ferments after single and repeated irradiation. The serum lipase and the blood catalase are diminished after a single irradiation, the lipolytic action of the serum being increased. The degree of ferment changes is not entirely dependent upon the intensity of irradiation. Repeated irradiation produces a decrease of catalase and a decided increase of lipase, the latter being probably due to the general cell lipase content and the lymphocytes.

H. C. OCHSNER, M.D.

Studies on the Survival Length of Leukocytes *in Vitro*, Tested by Their Ameboid Movements. Junkichi Ono. Trans. Jap. Path. Soc., 1929, XIX, 172-179. Abstracted in Zentralbl. f. d. ges. Radiol., Sept. 19, 1930, IX, 247.

The ameboid movements of leukocytes in blood withdrawn from the ear of the guinea pig continued for twenty-one hours, the blood being kept at 40° centigrade. Exposure to sunlight or to roentgen or radium radiation produced a definite diminution of the motility time. The effect of sunlight and ultra-violet was greatest.

H. C. OCHSNER, M.D.

BONE (DIAGNOSIS)

A Case of Osteopoikilia. Ernst Haack. Röntgenpraxis, July 1, 1931, III, 611-613.

The osteopoikilia is a relatively rare structural anomaly of the bones. To the author's knowledge only fifteen cases have been reported. Roentgenological examination of a 26-year-old man showed multiple small areas of increased density in the bones around the knee and shoulder joints. The etiology of this anomaly is not clear and it is apparently of no clinical importance.

H. W. HEFKE, M.D.

Roentgenologic Studies on the Appearance of the Ossific Nuclei and the Growth of the Carpal and Tarsal Bones. S. Koyanagi. Nagasaki Igakkai Zassi, VIII, 261-275, and Deutsch. Zusammenfassung, 1930, pp. 275, 276. Abstracted in Zentralbl. f. d. ges. Radiol., Dec. 12, 1930, IX, 592.

The ossific nuclei grow more rapidly in the first six months of life, appearing earlier and developing more in female than in male children. In most of these nuclei, increase in width precedes that of height, the growth of the right and left sides being equal. The appearance and growth of the nuclei parallel the increase of body length and weight.

H. C. OCHSNER, M.D.

Fracture of the Base of the Olecranon, with Anterior Luxation of the Bones of the Forearm. G. A. Oddone. Prensa Med. Argentina, June 10, 1931, XVIII, 55-57.

This type of fracture is infrequent. Bruns reports 1.2 per cent in 3,650, and Plagemman 2 per cent in 371 fractures of the elbow. There are three types of fractures: (1) Those of the vertex; (2) those of the middle, and (3) those of the base. The author explains the last class in detail, and presents a case of this type, reduced under fluoroscopy with good results.

N. G. GONZALEZ, M.D.

BONE DISEASES (DIAGNOSIS)

Lesions of the Hip-joint, with Aseptic Necrosis of the Head of the Femur. R. Kienböck and A. Selka. Röntgenpraxis, June 15, 1931, III, 541-544.

Aseptic necroses are not infrequently encountered in different diseases and injuries of joints. They are of great importance as influencing the course of the disease and the severity of symptoms. Often these necrotic areas of bone are not diagnosed roentgenologically, but are plainly evident upon examination after their presence has been established. Two cases are described: one in a woman, two years after a fracture of the head of the femur, and the other in a woman with a congenital subluxation of the hip. The aseptic necrosis is, of course, only a complicating feature of the primary lesion.

H. W. HEFKE, M.D.

Morphology of Congenital Coxa Vara. Lothar Kreuz. Arch. orthop. Chir., 1930, XXVIII, 106-127. Abstracted in Zentralbl. f. d. ges. Radiol., Sept. 19, 1930, IX, 243.

For a period of several years, the author observed a child, first brought to him at the age of eight months. The first observation revealed a shortening of the left leg, with external rotation, a normal acetabulum, the neck of the left femur being separated from the acetabulum by a greater distance than that of

the right. At 14 months there was a wider space between the nucleus of the head and the neck of the femur on the left than on the right. The neck of the femur was thicker and it was directed upward. At three and one-quarter years after the first observation, the left leg was shortened 3.5 centimeters. On the right, the epiphyseal line was horizontal, and the neck was directed upward. On the left, the epiphyseal line was vertical and there was a flaky rarefaction of the neck. At five years the epiphyseal line on the left was almost horizontal, but the trochanteric epiphysis was smaller on the left than on the right. Hoffa's conception that a vertical epiphyseal line is pathognomonic of congenital coxa vara is not borne out in these cases. The atrophy of the femoral head is due to disuse. There is usually a coxa valga on the opposite side. The cause of the condition is a disturbance of ossification.

H. C. OCHSNER, M.D.

Osteitis Fibrosa. H. Meyer-Borstel. *Bruns' Beitr.*, 1930, CXLVIII, 510-541. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 266.

The author observed 22 cases of osteitis fibrosa, 13 of which were the cystic type of Recklinghausen and 9 the deforming type of Paget. The localized, as well as the generalized type, can be traced to endocrine (thyroid, pituitary) disturbances. A transition from the monostic to the generalized form is possible. Medullary hematomas and traumatic medullary hemorrhage, rickets, and osteomalacia have been excluded as etiologic factors. Spontaneous healing is possible but infrequent. Local irradiation is ineffective, but endocrine irradiation may be of assistance.

H. C. OCHSNER, M.D.

Congenital Generalized Exostoses. Ion Tomesku. *Arch. orthop. Chir.*, 1930, XXVIII, 56-72. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 264.

In the upper and lower ends of the bones of

the extremities of a nine-year-old boy were found jagged, bony protuberances. There were also exostoses of the carpal bones, only the skull, the ribs, sternum, vertebræ, scapulæ, and pelvis being free of them. Examination six years later disclosed no evidence of the exostoses previously observed.

H. C. OCHSNER, M.D.

Cleido-cranial Dystocia. K. Klinke and H. Pahlke. *Arch. Kinderheilk.*, 1930, XCI, 46-54. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 591.

This is a report of two cases in early childhood, with complete absence of both clavicles and failure of ossification of the fontanelles. There was no hereditary taint, and the mineral constituents of the serum were normal; therefore rickets and osteitis fibrosa could be excluded. There was no evidence of hypophyseal disturbance. The authors feel that this disease is due to a primary disturbance of ossification in the membranous bones analogous to osteogenesis imperfecta in cartilaginous bones.

H. C. OCHSNER, M.D.

About Silent Bone Infractures as the Cause of Diseases of Diaphyses and Epiphyses. Behr and Körner. *Röntgenpraxis*, July 1, 1931, III, 586-593.

During the War a disease called "trench-periostitis" of the diaphysis of the leg was discussed repeatedly. The authors have had the opportunity of seeing five similar cases in policemen. Clinically, the men had definite points of tenderness over the tibia. Roentgenologic examination showed either a circumscribed periosteal thickening, or infractures or fissures in that area. This picture may best be explained by small "undramatic" fractures, which led to no acute symptoms. The same holds true of the primarily not recognizable fractures of metatarsal bones, which become evident roentgenologically only after callus has been formed. It is possible that such

fractures take place without a trauma sufficiently painful to be remembered by the patient.

The group of diseases called "epiphyseal necroses," including Köhler's disease and Perthes' disease, might be caused by a very similar mechanism. "Silent" fractures might lead to necrosis of certain portions of the bones. A fracture in the small bones of the foot or wrist can easily escape roentgenologic demonstration and may be shown only after the malacia has taken place. Perthes' disease of the hip has been explained by non-infected embolisms or endocrine disturbances. In this case also, the authors think a traumatic genesis much more probable.

H. W. HEFKE, M.D.

Parathyroid Tumors in Recklinghausen's Osteitis Fibrosa. I. Snapper. *Wien. klin. Wchnschr.*, 1930, I, 312-314. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 266.

This is a report of a surgically cured case of generalized osteitis fibrosa cystica with pseudo-malacia. The unusually high calcium content of the serum (from 20 to 23 mgs. per cent) called attention to the hyperfunction of the parathyroid. Mandl and Gold had reported similar cases. Differentiation from the other types of osteitis fibrosa can be established by the fact that in them the blood and urine calcium show little departure from normal.

H. C. OCHSNER, M.D.

Possible Etiologic Factors in the Production of Pulmonary Osteo-arthritis. Edward L. Compere, W. E. Adams, and C. L. Compere. *Pros. Soc. Exper. Biol. and Med.*, June, 1931, XXVIII, 1083, 1084.

The authors were unsuccessful in their attempts to produce the following: (1) New periosteal bone by pressure upon a lung from a foreign body in the pleural cavity; (2) stenosis of a primary or secondary bronchus; (3) collapse or total absence of a lobe, or of

an entire lung; (4) pleurisy with effusion, and (5) solitary lung abscess.

From 100 to 300 c.c. of paraffin were injected into the right pleural cavity of each of nine dogs. A pleural effusion resulted in every case, which, in addition to the mechanical pressure on the lung by the paraffin, almost completely displaced the air-containing tissue in the right lung. Frequent X-ray examinations failed to reveal any evidence of new bone formation along the shafts of the long bones. Blood chemistry studies showed no changes in the calcium, phosphorus, carbon dioxide, and H ion concentration of the blood serum.

Collapse of the lobes of the lungs of thirteen dogs was accomplished. A lung abscess developed in one case and lobectomy was performed upon five dogs at varying intervals, following collapse of the lobe or of the corresponding lung. Roentgenograms and blood chemistry studies revealed no changes similar to those described as pulmonary osteo-arthritis.

J. N. ANÉ, M.D.

BONE DISEASES (THERAPY)

The Acro-osteopathies. Antonio Merlini. *Arch. orthop. Chir.*, 1930, XXVIII, 73-83. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 267.

The author classifies epicondylitis of the humerus and femur as acro-osteopathies, both having a typical roentgenologic appearance. Treatment should be conservative, roentgen therapy and diathermy being indicated. The prognosis is good if the part be put at rest.

H. C. OCHSNER, M.D.

The Treatment of Chronic Osteomyelitis with the Maggot (Larva of the Blow Fly). William S. Baer. *Jour. Bone and Joint Surg.*, July, 1931, XIII, 438-475.

This posthumous publication describes Baer's famous work in detail.

In 1917, war wounds involving compound fracture of the femur caused death in 80 per

cent of cases in spite of the best efforts of army surgeons. The author noted and remembered, however, that two such cases did surprisingly well when, through accident, they lay seven days on the battlefield without food, water, or medical attention, but with the presence of many thousands of maggots in their wounds.

Napoleon's Larrey had seen maggots helping Nature heal wounds of French soldiers early in the nineteenth century. Wellington's Millingen saw no good in maggots encountered when the English wounded retreated from Talavera in the heat of July, 1809, and even learned from the Spaniards how to destroy them by pouring olive oil on the dressings. Keen thought that maggots in the Civil War wounds of Union soldiers were harmless but disgusting. Zacharias, on the other hand, considered maggots the most effective cleansing agent at his disposal and deliberately introduced them into the wounds of Confederate soldiers.

Knowing this, the author, in September, 1928, used maggots to treat four cases of chronic osteomyelitis. First, the wounds were opened and all dead tissue removed. Then maggots were introduced. In six weeks' time the wounds were completely healed.

In a second series the following year three cases were complicated by gas bacillus infection and eight by tetanus, and, though all recovered, it was obvious that in the future only sterile maggots could be used.

Masses of eggs that had been deposited on raw beef were hatched under conditions of controlled temperature and humidity. The larvæ were fed on beef until pupæ developed, and the flies that emerged five to seven days later were used to provide more eggs.

When such eggs are placed in test tubes and gently agitated for thirty minutes in a mixture of one to two thousand parts bichlorid of mercury, 25 per cent alcohol, and 0.5 per cent hydrochloric acid, their outside is sterilized and larvæ hatched from them are sterile inside and out. The larvæ feed for two days on a sterilized mixture of liver, beef, agar, and yeast, during which time they are tested for sterility. On the third day, they are ready to be

placed in wounds, or they may be held inactive for several days by placing them in a 40° F. refrigerator. In preparing wounds, soap and water are used to remove dirt and grease, but antiseptic chemicals are avoided because of their harmful effects on the larvæ. Skin edges are taped with adhesive so that the maggots will not tickle the patient, and padded, open-topped cages are firmly attached to the wound. The open top of the cage admits the air needed by the maggots and the sunlight or artificial light that warms them and drives them deep into the wound for food and shade.

In twenty-four hours the reaction of the wound becomes alkaline. Later the bacterial count falls. All dead material is eaten up and fresh live granulation tissue develops. At the end of the fifth day the larvæ, being about ready to become pupæ, are removed and fresh maggots are added. After repeating this for about six weeks the wound heals.

Acute osteomyelitis is said to run a shorter course if maggots are introduced into the surgical wound five days after the first incision into the bone. In old tuberculous lesions, at least the complicating pus infection is improved.

PAUL C. HODGES, M.D.

BONE TUMORS (DIAGNOSIS)

Osteogenic Sarcoma: An Observation on the Lower Extremity of the Femur. Pedro Chutro and Ernesto Cornejo Saravia. *Semana Méd.*, December 18, 1930, XXXVII, 1877-1883.

Disarticulations or amputations in cases of osteogenic sarcoma are not performed for the purpose of preventing further growth, but to relieve pain, prevent pathologic fractures, for psychologic reasons, etc., since sarcomas always metastasize. This metastasis probably comes from the gelatin-like edema around the tumor. The authors believe that such edema represents the plasma of the tumor. Although metastasis appears soon after amputation or disarticulation, they believe that (though unable to prove it) such metastasis exists before operation. They base this on the fact that the patients do not improve after opera-

tion and that they do not live any longer than those who do not have any surgical interference.

The case here presented is that of a boy sixteen years old who gave the history of a fall. Following this, he developed pain in the knee, which remained until he came to the writers two months later. A tumor about the size of the head of a small child was seen. The radiograph presented a typical picture of osteosarcoma, which had invaded the epiphysis and destroyed the cortex. The film showed light and dark areas; the articulation was not invaded. Disarticulation of the hip was resorted to, the pathologic report being osteogenic sarcoma.

The authors conclude that the cases reported to have lived many years after amputation or disarticulation were wrongly diagnosed, for true osteogenic sarcomas reappear a few months after operation; also, that the edema around the tumor constitutes the plasma of the tumor, and that osteogenic sarcoma, in its late stage, may invade the articulation but never the synovial membrane.

N. G. GONZALEZ, M.D.

A Case of Hemangioendothelioma of the Bones of the Wrist. J. E. Pritchard. *Canadian Med. Assn. Jour.*, May, 1931, XXIV, 689-692.

This is a case report from the Department of Pathology of the Montreal General Hospital.

The patient gave a history of injury to the right wrist while cranking a car. Three months later, a radiograph showed a fracture of the greater multangular and styloid process of the radius, and rarefaction of the lower end of the radius, trapezium, scaphoid, and first metacarpal. Nine weeks later, the condition had progressed. Enlarged lymph nodes appeared in the right axilla and epitrochlear region. One was removed for biopsy and showed hyperplasia but no evidence of tumor. The case was then diagnosed as a bone tumor, probably Ewing's endothelial myeloma, and X-ray treatments instituted. Three treatments, totalling 800 r-units, were given dur-

ing seven weeks, with no response. An amputation was then done through the middle of the forearm.

Microscopically, the tumor was a hemangioblastoma, showing evidence of malignancy. The Committee of the Bone Sarcoma Registry of the American College of Surgeons, who divide the angioblastomas into the benign angiomas and the malignant angioendotheliomas, have classed it as an angioendothelioma.

That this is a rare tumor is evidenced by the fact that, in a series of 1,000 bone tumors from the Bone Sarcoma Registry of the American College of Surgeons, there were only eight angiomas and no angioendotheliomas.

L. J. CARTER, M.D.

BONE TUMORS (THERAPY)

Changes in Bone Tumors after Intravenous Injections of a Colloidal Solution. Arthur C. Hendrick and E. F. Burton. *Canadian Med. Assn. Jour.*, May, 1931, XXIV, 642-646.

This is a report of four cases of bone sarcomas treated by the injection of a colloidal solution. A colloidal solution of metallic arsenic was employed, made by the technic of E. F. Burton, of the University of Toronto. Cataphoresis had shown that the colloidal particles were negatively charged, and hence safe for intravenous injection. Animal experimentation also demonstrated that the solution, when given intravenously, was non-toxic and produced no untoward effects, either immediate or remote.

To demonstrate the changes in the pathology of bone tumors, following a series of intravenous injections of the solution for varying periods, stereoscopic films were made at intervals of about three months, since the radiogram is one of the most important single findings which will at once allow of conclusions as to the changes observed. Biopsy was not considered advisable.

Among present-day research workers in the treatment of bone sarcomas, calcification and ossification are usually looked upon as very

encouraging signs of the effects of treatment. When these are accompanied by a retardation or cessation of bone destruction by the tumor cells, the result is a very striking one. In all of the four cases reported in this series, increased calcification and ossification were noted in the radiograms, together with apparent retardation and cessation of bone destruction by the tumor cells. It is usually assumed that the erosive action upon the involved bone is affected by the tumor cells only while they are undifferentiated and rapidly growing, and hence plastic, mobile, and possibly phagocytic, though not in the strict sense of the word as used by Champy.

Some observations made during the treatment of carcinoma with the colloidal solution also led to the conclusion that the young, undifferentiated, and plastic cancer cells were similarly destroyed.

L. J. CARTER, M.D.

CANCER (DIAGNOSIS)

Alkalinity of the Blood in Relation to the Prognosis in Cancer. Editorial. *Jour. Am. Med. Assn.*, June 27, 1931, **XCVI**, 2199.

From studies on healthy persons, as well as on those with acidosis or alkalosis, physiologists may ascribe the neutrality of the blood to a system of acidity regulators or buffers, which, in the case of the blood, consist of mixtures of weak acids and their salts. Governing the acidity or alkalinity of the blood are the ratios of each particular acid to its corresponding salt.

As the hydrogen-ion concentration is but one of the three variables in an equation expressing the acid-base balance of the blood, its measurement has found little use in the clinical laboratory. Neglect of the consideration that it alone is not a safe criterion of a patient's tendencies towards alkalosis or acidosis may be responsible for the discordant opinions as to whether or not alkalosis is a concomitant of cancer.

The work of a group of Philadelphia investigators shows patients with untreated malignant conditions to exhibit a correlation of al-

kaline hydrogen-ion concentration with a shortened span of life. They avoid any assumptions, for they undoubtedly recognize that the prognosis in cancer is somewhat dependent on the degree of co-existing cachexia and anemia, and that a diminution in hemoglobin may effect an increase in hydrogen-ion concentration.

These investigators have reopened a question deserving intensive study.

C. G. SUTHERLAND, M.D.

How Early do Physicians Diagnose Cancer of the Stomach in Themselves? A Study of the Histories of Forty-one Cases. Walter C. Alvarez. *Jour. Am. Med. Assn.*, July 11, 1931, **XCVII**, 77-83.

The patient is slow to realize that he is seriously ill. Many allow themselves to drift along, usually in courses of treatment for supposed ulcer or functional disturbance. After a specified age, routine roentgenologic examination of the stomach might assist, but in actual practice such a regimen seems impossible. Indigestion, abdominal pain, or weakness in the latter half of life demands a careful roentgenologic examination. The tendency to interpret the roentgenologist's report of ulcer as meaning a benign ulcer misleads many physicians. Nearly all patients with benign ulcer have long histories, while nearly all with cancer have short histories.

The great usefulness of the barium meal in the recognition of carcinoma of the stomach is shown by the fact that out of 1,104 patients examined, an operation was ordered for only 14, in the face of a negative roentgenologic report. In 30 per cent of a series, expert roentgenologists were unable to say definitely that the lesion they saw was cancer.

It seems obvious that the only way in which one can hope to cure cancer of the stomach is by excision during the stage when it looks and behaves like a benign ulcer. It would help much if every disturbance of digestion that appears suddenly in a middle aged or elderly individual were looked upon with grave suspicion. It is for the patient with the short his-

tory that the experienced gastro-enterologist has learned most to fear.

So long as most physicians are willing to treat epigastric pain in older persons expectantly and without consultation with expert roentgenologists, and so long as they are willing to treat gastric ulcer medically without fortnightly roentgenologic supervision, there can be no hope of lessening the mortality from cancer of the stomach.

C. G. SUTHERLAND, M.D.

CANCER (THERAPY)

Bilateral Embryonal Carcinoma of the Testicle: Report of a Case. J. M. Venable and O. P. Flynt. *Jour. Urol.*, July, 1931, XXVI, 155-161.

The authors report a case of bilateral embryonal carcinoma, in a patient 60 years of age, which followed a history of trauma six years preceding. Both testicles were removed by consecutive operation and the patient made an uneventful recovery. The operative treatment was to be followed up by deep X-ray.

There was no evidence of metastases anywhere in the body.

DAVIS H. PARDOLL, M.D.

Does Carcinoma of the Duodenum Ever Arise from Duodenal Ulcers? J. William Hinton. *Am. Jour. Med. Sciences*, June, 1931, CLXXXI, 843-850.

This article, accompanied by reports from the Mayo Clinic, contains a review of the reported cases of primary carcinoma of the duodenum, and also reports by McGuire, Cornish, Lichty, and many other pathologists on the results of postmortem examination. It has been found that carcinoma of the duodenum occurs in from .027 to .033 per cent of cases.

The author also reviews several cases of his own in which there was carcinoma of the duodenum, the origin of which could not be directly traced to duodenal ulcers. It is dif-

ficult to explain why these cases do not undergo carcinomatous degeneration. While primary carcinoma of the duodenum is occasionally seen, clinically, one can disregard the possibility of the duodenal ulcer ever taking on malignant degeneration.

ROE J. MAIER, M.D.

Treatment of Epitheliomas of the Eyelids. M. Appelmans. *Rev. Belge des Sciences Méd.*, December, 1930, X, 829-839.

At the Cancer Institute of Louvain, in 5,000 cases of cancer, about 100 were found to be of the eyelids. Of these, 75 cutaneous cancers of the eyelids were treated by the author. The ratio of involvement was four of the lower lid to one of the upper. The most frequent location on the upper lid was the external canthus; on the lower, the internal canthus. The majority of the cases on the lower lid did not involve the lachrymal apparatus. Both eyes were involved in about the same percentage, likewise both sexes, the frequency increasing with age.

Of the 75 cases studied by the author, 6 died directly from the effect of the cancer, with involvement of the eyeball. Cancers near the internal canthus are less favorable than those of the external canthus.

The results were as follows: Cured, 27; cured, but with impaired function, 37; failures, 11.

After one year of observation, the final results in 60 cases were as follows: Cured, 27; died, 8; recurred, 4; no response to inquiry, 21. The perfect cures were obtained in cases in which the epithelioma was purely cutaneous.

The following method of treatment was employed: Tubes containing 2 mg. of the element were used. They were 12 mm. long, filtered with 1 mm. of platinum. These were applied for 72 hours. At the external canthus they were applied directly to the skin, being held by adhesive plaster. After-treatment consisted of a wash of peroxide of mercury (1-10), followed by an application of Lassar's paste softened by the addition of an equal amount of vaselin and lanolin. The dressing

was left open to the air; only one layer of gauze was used.

At the internal canthus, the tubes are placed at a distance of 3 cm. or from 5 to 6 centimeters. The eye is protected with lead.

For cancers of the soft parts, 100 mg., 1 mm. platinum filter, distance 3 cm., 1.5 mc. per sq. cm. of surface. Needles are also used in these cases, employing 0.5 mc. per square centimeter. If the eye is completely involved, it is removed by electrocoagulation or the diathermy knife, and the cavity cleaned out. Radium is then applied in the small 2-mg. tubes, placed 1 cm. center-to-center for a duration of 36 hours.

Of the cases in which the skin alone was involved 100 per cent were cured.

LESTER J. WILLIAMS, M.D.

CHEMICAL

The Allotropy of Rhodium and Some Phenomena Observed in the X-ray Analysis of Heated Metal Wires. F. M. Jaeger and J. E. Zanstra. *Proc. Acad. Sci. Amsterdam*, 1931, XXXIV, 15-32.

Jaeger and Rosenbohm (*Chem. Abs.*, XXIV, 4678) demonstrated that there is a maximum in the $c_p - t$ curve for Pd at 1530° and for Rh at about 1,200°. To determine whether a structural change in the metals takes place at these temperatures X-ray spectrograms by the Debye-Hull method were made of the metal formed under different conditions and after receiving various heat treatments. Powdered Rh from reduction of Rh salts gave broad and hazy diffraction lines suggesting colloidal form. When the powder was wrapped in Pt foil and heated to 1,500° the pattern was the same as that of Rh wire. Two forms of Rh are suggested, α and β , both of which are present at lower temperatures; the α form decreases in amount as the temperature increases until at 1,000° only the β form is present. As a Rh wire was heated the lines in the diffraction pattern were gradually replaced by dots, due to growth of the crystals and their orientation with their axes along the long axis of the wire. At 750° doublets were formed, i.e., the

diffraction lines split into two lines each, one bright and one faint satellite. As the temperature was increased, the ratio of the relative intensities of the components of each doublet was shifted toward an increasing intensity of the satellite in comparison with the first line. The distance between the two lines of a doublet increased with increasing temperature. Rotation of the heated wire caused reappearance of lines in the spectrum where dots had replaced lines as the wire was heated. Pd and Pt showed similar phenomena.

CHEMICAL ABSTRACTS.

Elements of X-ray Analysis by the Powder Method. L. W. McKeehan. *Metal Progress*, 1931, XIX, No. 6, pp. 71-76.

The appearance of a definite pattern with invariable positions and intensities of lines is positive proof of the appearance of a distinct phase. Diagrams are given.

CHEMICAL ABSTRACTS.

Scattering of Gamma Rays. J. C. Jacobsen. *Naturwissenschaften*, 1930, XVIII, 951, 952.

The scattering of Ra γ -rays on passing through solutions of various substances was followed by means of an Au-leaf electrometer. A graph of the ionization current against the number of electrons per c.c. gives a smooth curve, showing that the weakening of the radiation is determined by the number of electrons encountered.

CHEMICAL ABSTRACTS.

Luminescence Due to Radio-activity. D. H. Kabakjian. *Phys. Rev.*, 1931, XXXVII, 1120-1128.

The results of several investigations on luminescence due to radio-activity cannot be explained on the active-center theory of Rutherford or any modification of it. In certain substances, including ZnS, there is an initial rise in brightness of the irradiated samples, followed by a decay which cannot be

represented by a simple exponential curve. The rate of decay of brightness is not strictly proportional to the rate of emission of luminous energy, as required by the theory. The observed facts can be explained qualitatively by assuming that the α -, β -, and γ -rays produce excited molecules in the luminescent material. The luminous energy is emitted on the return of the molecule to its initial state. The rays also affect the transmission coefficient of the materials and the apparent decay of brightness is explained as being due to the increased absorption of light by the material itself rather than to the destruction of assumed active centers. The author believes that the restoration of the original brightness is attested to by this fact.

CHEMICAL ABSTRACTS.

Ionization by X-rays Crossing the Thin Walls of a Small Sphere. W. Mund. *Bull. Soc. Chim. Belg.*, 1930, XXXIX, 518-528.

An equation has been established, which makes it possible to compute the ionization around a small sphere filled with Rn.

CHEMICAL ABSTRACTS.

Polarization in Photo-electric Conductivity Arising from X-ray-excited Rock Salt. P. Tartakovskii. *Ztschr. Physik*, 1930, LXVI, 830-833.

A thin plate of rock salt was placed between the poles of an electromagnet, and the Hall effect was used to give a preponderance of free electrons towards one side of the plate. When the magnetic field was removed, the corresponding half of the plate showed a lower conductivity. Hence free electrons increase the polarization.

CHEMICAL ABSTRACTS.

Dangers in Refining Radio-active Substances. Herman Schlundt, William McGavock, Jr., and Mildred Brown. *Jour. Ind. Hyg.*, 1931, XIII, 117-134.

The investigations were carried out over a

period of three years in a laboratory where the final stages of refining commercial MsTh in 100- to 300-mg. quantities were carried out. Gamma radiations and the radio-active gases, radon and thoron, were the sources of danger. Precautions were taken to reduce these dangers to a minimum and then the laboratory atmosphere and workers were carefully examined for radiation. The thoron content was 10^3 greater than the radon content and constituted the chief danger, as the gamma radiation was small. A method for the determination of thoron in the laboratory atmosphere was devised and showed 10^{-4} curies of thoron per cubic meter as a representative value, and under these conditions the lungs of a worker will contain 9×10^5 atoms of thoron and 1,400,000 α -particles, will be produced per minute, which is approximately 2 per cent of the number occurring in the body of a person carrying an amount of Ra just within the limits of tolerance. Workers were examined monthly by the γ -ray method (less reliable) and the expired-air method. The latter method gives a timely warning of danger sooner and more accurately than any other. Workers develop a distinct radio-activity with time, but lose it gradually. One worker showed, by the expired-air method two days after stopping work in the laboratory, a net drift of 22 divisions, but three months later only 1.9 divisions. Blood counts of three workers showed no abnormalities. None of the five workers experienced any debilitating effects. Previous workers in the laboratory before precautions were used did not show any harmful effects ten years after ceasing work.

CHEMICAL ABSTRACTS.

X-ray Diffraction by Incandescent Carbon. Moriso Hirata. *Sci. Papers Inst. Phys. Chem. Research, Tokio*, 1931, XV, 219-226.

X-ray diffraction photographs obtained from the incandescent positive and negative electrodes of the C arc were studied. The thermal expansion of graphite takes place only in the direction perpendicular to the most closely packed plane (002), and this average

expansion coefficient is of the order of 40×10^{-6} , much larger than the same quantity obtained at lower temperatures. Variations in spacing of planes perpendicular to (002) are negligibly small. Reflections due to oblique planes such as (301) or (203) and also second order due to (002) are diminished in intensity in the incandescent state. Some amorphous scattering at the positive electrode was detected. As an explanation of this scattering, the existence of some combination of C with impurities in the molten state is suggested.

CHEMICAL ABSTRACTS.

Change of Wave Length of X-rays on Traversing an Absorbing Medium. J. M. Cork. *Compt. rend.*, 1931, CXCII, 153-155.

The new lines stated by Ray (*cf.* Chem. Abs., XXIV, 4213) to be produced on passing Cu $K\alpha$ radiation through C, etc., were not obtained when his experiment was repeated, nor could any such effect be obtained with B.

CHEMICAL ABSTRACTS.

Anomalous X-ray Diffraction Intensities. W. A. Wood. *Nature*, 1931, CXXVII, 703.

The X-ray Debye photograph of gray mat deposit of Cr on wire gave lines of the expected intensities corresponding to the (200), (110) and (211) reflections. The (211) line is unusually broad; this fact indicates submicroscopic crystals. A similar deposit with brilliant luster gave the same (211) and (110) lines, but no (200) line. It is suggested that the crystals grow in one or two directions only, until the third contains too few reflecting components still to have a noticeable effect in the case of submicroscopic crystals.

CHEMICAL ABSTRACTS.

The Influence of Radiative Forces on the Scattering of Electrons. N. F. Mott. *Proc. Cambridge Phil. Soc.*, 1931, XXVII, 255-267.

Radiative forces are usually neglected in formulas for electron scattering by atoms.

Theoretical and experimental results differ by as much as 40 per cent for large-angle scattering of high-speed electrons, and it was thought that radiation might account for the discrepancy. Complete mathematical treatment shows these forces to be no greater than 2 or 3 per cent for electrons of any velocity. Some remarks are also made about continuous X-ray emission spectra and they are compared with results of Gaunt (Chem. Abs., XXIV, 3951).

CHEMICAL ABSTRACTS.

X-ray Diffraction of Some Organic Substances in the Solid and Liquid States. Shinsuke Tanaka, Genjiro Okuno, and Akira Tsuji. *Mem. Coll. Sci. Kyoto Imperial Univ.*, Ser. A, 1931, XIV, 67-71.

Phenanthrene, α - and β -naphthol and α - and β -naphthylamine were investigated in both the solid and liquid states by means of Debye-Scherrer X-ray photographs. The general conclusions are that a substance which shows an intense crystal line shows also a band in the liquid pattern corresponding to the crystal line, that the spacing of the positions of maximum intensity of the liquid band is generally greater than that of the corresponding crystal line, and that the crystal planes seem to maintain their properties when the crystal becomes liquid.

CHEMICAL ABSTRACTS.

The Dependence of X-ray Absorption Spectra upon Chemical and Physical State. J. D. Hanawalt. *Phys. Rev.*, 1931, XXXVII, 715-726.

The X-ray absorption spectra of As, Se, Br, Zn, Hg, Xe, and Kr and of compounds of some of these elements have been photographed for both the solid and the vapor states at a dispersion of 5 x. u. per millimeter. The effect of the chemical and physical state of the absorbing atom upon the secondary structure which lies to the short wave side of the main absorption edge was investigated. It was found that: (1) the monatomic vapors Zn, Hg, Xe, and Kr exhibit no secondary structure

at a distance from the main edge greater than the ionization potential of the atom; (2) polyatomic vapors usually have a secondary structure similar to that shown by the same molecule in the solid state; (3) a polyatomic molecule in the solid state often exhibits an additional structure which is absent when the molecule is in the vapor state; (4) in the secondary absorption of solid NaBrO_3 an additional structure appears which is absent in a solution of NaBrO_3 ; (5) completed electron shells of atoms in the solid state do not necessarily mean the absence of secondary absorption edges. Suggestions are made to account for this dependence of secondary absorption on molecular and physical state.

CHEMICAL ABSTRACTS.

Crystal Chemistry and X-ray Research. V. M. Goldschmidt. *Ergebnisse tech. Röntgenkunde*, 1931, II (separate), 151-182.

Except for incidental discussion of more recent work, this is largely a restatement of previous discussions of the modern explanation of the early empirical rules of crystal chemistry, the basis for co-ordination numbers, the co-ordination types as a basis for classification of crystals, the relation of various crystal properties to the properties, including polarization, of the particles contained. The use of recent concepts in studying silicates, intermetallic bonds, and highly polymerized organic structures is discussed. Tabulations are given of ionic and atomic radii. A bibliography of what the author considers the most important work in the field since 1928 is given.

CHEMICAL ABSTRACTS.

X-ray Study of the Coagulation Process of Colloidal Gold. P. Scherrer and H. Staub. *Ztschr. physik. Chem.*, 1931, Abt. A, CLIV, 309-321.

During coagulation of a highly disperse Au sol, the primary particles of the hydrosol form larger secondary particles of irregular structure. The primary particle size remains unchanged. Formation of larger crystals from

primary particles takes place during intensive drying at room temperature or if the coagulate is left in an electrolyte-containing solution. The velocity of crystallization depends on the nature of the initial sol. The velocity can be increased by raising the temperature. Protective colloids prevent the formation of larger crystals.

CHEMICAL ABSTRACTS.

X-ray Diffraction in Water: The Nature of Molecular Association. G. W. Stewart. *Phys. Rev.*, 1931, XXXVII, 9-16.

The X-ray diffraction intensity-angle distribution for water and its variation for temperatures of 2 degrees to 98 degrees are given. Two important periodicities are established at 3.24 and 2.11 Å.U. and a third at 1.13 Å.U. The first one decreases with temperature and the second increases. Molecular complexes are discussed. The author believes that the description of associations involving complexes of two or three molecules should be abandoned in favor of the molecular group conception (cybotactic state).

CHEMICAL ABSTRACTS.

Appearance of Extra Lines in X-ray Diffraction Patterns of Mixtures and Absence of Some Lines Peculiar to the Components of the Mixtures. Roy W. Drier. *Phys. Rev.*, 1931, XXXVII, 712-714.

Abnormalities in X-ray patterns of mechanical mixtures of minerals are described. The spectra of some show the presence of extra lines and in the spectra of others some lines peculiar to the components are missing. Possible reasons for this are discussed.

CHEMICAL ABSTRACTS.

The Fine Structure of X-ray Absorption Edges. J. Palacios and M. Velasco. *Anales Soc. Españ. fis. Quím.*, 1931, XXIX, 126-130.

It is pointed out that the fine structure of X-ray absorption edges, in all substances reported up to the present, first shows up when

the thickness of the absorbing layer is such that the difference in the transmitted intensity on the two sides of the edge is a maximum. Ni, Co and Fe were used in a study of this effect.

CHEMICAL ABSTRACTS.

Influence of Radium on Subacute Arsenic Poisoning. B. Boucek. *Compt. rend. Soc. Biol.*, 1930, CIV, 235-237.

Ra in the form of pitchblende was administered to guinea pigs simultaneously with As in successive doses to the limit of ordinary arsenical tolerance. About 2.4 mg. As per kg. is fatal in three days; but in combination with 1.6 mg. pitchblende a dose of 3.1 mg. As is well tolerated, and the animal improves in weight. However, in certain cases Ra interferes with the acquirement of tolerance for As; and when As is insufficient in amount to cause subacute poisoning, the addition of Ra makes it more toxic.

CHEMICAL ABSTRACTS.

X-ray Absorption in Gases. W. W. Colvert. *Phys. Rev.*, 1930, XXXVI, 1619-1624.

X-ray spectral lines reflected from a Pt-surfaced mirror and by a calcite crystal have been used for absorption measurements with Ne, SO_2 , Cl and A. Results are given in tabular form.

CHEMICAL ABSTRACTS.

The Wave Length and Structure of the K-absorption Edge of Cobalt. M. A. Valouch. *Collection Czechoslov. Chem. Comm.*, 1931, III, 205-215.

A study has been made of the wave length and structure of the X-ray K-absorption edge of Co, in the form of metallic films as well as in alcoholic and aqueous solutions of $\text{CoCl}_2 \cdot 6\text{H}_2\text{O}$. Respective values in x. u. of the wave lengths of the absorption edges due to the different forms in order named are: 1604.4, 1602.6 and 1602.2. The fine structure of the K-absorption edge, which has been ob-

served in all cases, is relatively more noticeable for the solutions than for metallic Co, a difference which may possibly be due to the thickness of the absorbing layer.

CHEMICAL ABSTRACTS.

The Atomic Photo-electric Effect with Great Hardness of the Exciting Radiation. Fritz Sauter. *Ann. Physik*, 1931, IX, 217-248.

A method is devised for obtaining the wave function of an ejected photo-electron in closed form, using non-relativistic polar coördinates. Photo-emission from the K and L shells is calculated, and the Sommerfeld-Schur formulas (for relatively soft exciting radiation) are shown to be first approximations. The relativistic theory of the photo-electric effect in conjunction with Dirac's equations is also developed.

CHEMICAL ABSTRACTS.

The Intensity of X-rays Reflected from Platinum, Silver, and Glass. Hiram W. Edwards. *Phys. Rev.*, 1931, XXXVII, 339-343.

The intensity of a monochromatic beam of X-rays reflected from Pt, Ag, and glass mirrors was measured for angles of incidence varying from 0.75 to 1.25 times the critical angle. Calculated values by Thibaud's modification of Fresnel's equation agree with experimental values for Pt but not for Ag or glass mirrors.

CHEMICAL ABSTRACTS.

Observations Concerning the Causative Agent of a Chicken Tumor. James B. Murphy, O. M. Helmer, Albert Claude, and Ernest Sturm. *Science*, 1931, LXXIII, 266-268.

This is a report of additional observation on the properties of a filtrable agent causing chicken tumor. The agent of Chicken Tumor I, a spindle-cell sarcoma, is selectively adsorbed and fixed by certain mesodermal tis-

sués from susceptible animals. The plotted curve of the amount of ultra-violet light of selected wave lengths required to inactivate the tumor agent shows a significant qualitative and quantitative variation from the curves for bacteria, typical viruses, and bacteriophage. The tumor-producing activity of the filtrates can be precipitated out with a protein fraction and purified. The steps in the purification of the agent are outlined and the evidence of an inhibiting principle in the chicken tumor is discussed.

CHEMICAL ABSTRACTS.

Scattering of X-rays from Gases. E. O. Wollan. *Phys. Rev.*, 1931, XXXVII, 862-872.

Measurements have been made of the intensity of scattering of X-rays by H_2 , O_2 , He, Ne and A for the scattering angles 10° and 90° .

CHEMICAL ABSTRACTS.

Technical Considerations in the X-ray Testing of Materials (II). A. Herr. *Mitt. staatl. tech. Versuchsamtes*, 1930, XIX, 60-78.

A discussion of the introduction of X-ray equipment into technical laboratories for testing materials. Apparatus for investigating the gross structure of large parts is described, including a stereobinocular set-up for locating defects accurately. Metallic X-ray tubes equipped with protective mantels for high tension are shown.

CHEMICAL ABSTRACTS.

Diffraction of X-rays in Liquids; Effect of Temperature. E. W. Skinner. *Phys. Rev.*, 1930, XXXVI, 1625-1630.

The effect of temperature upon X-ray diffraction has been examined for mesitylene, 4-hydroxy-1,3-dimethylbenzene, 2-hydroxy-1,3-dimethylbenzene, phenol, naphthalene, benzene, cyclohexane, dipropylcarbinol, heptylic acid, *tert.*-butyl alc., lauryl alc., octane, 2,7-di-

methyloctane and 2,4-trimethylpentane. Results and conclusions are discussed.

CHEMICAL ABSTRACTS.

Theory and Practice of X-ray Analysis. William H. Barnes. *Canadian Chem. Met.*, 1931, XV, 67-70.

A short review with brief mention of some of the fundamental conceptions on which the subject is based and an outline of a few of the fields of application. The production, nature of X-radiation and physical chemistry and biologic effects thereof are discussed. Applications to spectroscopy and crystallography are noted.

CHEMICAL ABSTRACTS.

CHEST (DIAGNOSIS)

Roentgenologic Diagnosis of Pleural Effusions. Joseph W. Post. *Jour. Am. Inst. Homeop.*, June, 1931, XXIV, 580-582.

A roentgenologic study of pleural effusion depicts increase or decrease of fluid, amount of lung compression and displacement of surrounding organs, re-establishment of lung expansion, and the formation and location of any subsequent pleural thickening, adhesions, or calcareous infiltration. The author stresses the importance of the fluoroscopic examination and lateral roentgenograms, in addition to the postero-anterior examination. Increase of fluid is observed, due to elevation of the area of generalized increased density and a characteristic upper border, taking the form of a slightly concave oblique line extending from above downward and from the thoracic wall inward toward the lung root. This curved upper border is not found in the encysted type of pleurisy, a distinct fluid level being noted in the presence of a pneumothorax.

In the pre-exudation stage, fluoroscopy will show an immobilization of the diaphragm in all forms of effusion of inflammatory origin. The density of an effusion is nearly uniform, being more intense at the base. The shadow of

the ribs is more likely to become obliterated in adults than in children.

Lateral roentgenograms are essential for the study of interlobar and medial encysted effusions. The interlobar type, corresponding to one of the normal fissure levels, is seen on the postero-anterior roentgenogram as a band-like shadow of increased density across the affected hemithorax, while a medial encysted effusion appears as an additional shadow of increased density overlying the normal inferior mediastinal and heart shadows.

J. N. ANÉ, M.D.

Foreign Body Granulations in the Lung after Diagnostic Bronchography. E. Morvay. *Röntgenpraxis*, July 1, 1931, III, 581-586.

Four months after bronchography with iodipin a large amount of the contrast medium was still present in a woman with a thoracic tumor. It was found on the side opposite the one filled during the bronchoscopy. There had been no difficulty at the time. After the bronchography some of the contrast material was aspirated into the other side during a coughing spell, and a large part of it was retained in the right lung. The clinical and roentgenologic picture of a foreign body granulomatosis developed afterwards and remained constant for one year. It is pointed out that the demonstration of the bronchial tree by means of iodine-containing contrast media might lead to such undesired after-effects and that one should use the method only when it is definitely indicated.

H. W. HEFKE, M.D.

The Interrelationship of Non-tuberculous Upper and Lower Respiratory Disease. Jabez H. Elliott. *Canadian Med. Assn. Jour.*, May, 1931, XXIV, 657-659.

It is difficult to classify the various methods by which disease in the upper respiratory tract leads to disease in the lower respiratory tract. The relationship appears very clear in such cases as acute rhinitis, where the infection spreads rapidly, or at times slowly, down-

ward, with successively a pharyngitis, a laryngitis, a tracheitis, at times a bronchitis, a bronchiolitis, or a pneumonia. Nasal obstruction from any cause, leading to mouth breathing, results in the aspiration into the bronchial tree of air insufficiently warmed or filtered, and of relatively low humidity. This causes a hyperemia of the bronchial mucosa, with increased secretion and the symptoms of a subacute bronchitis. We have to consider, too, the aspiration of septic material into the bronchial tree from the upper passages, whether this be secretion from post-nasal and oral dripping, or infected material dislodged during the course of some operation in the oro-nasal cavities. Spread may also occur to the lungs through the blood and lymph streams, explaining some of the cases of pulmonary abscess which follow oro-nasal sepsis.

Lobar Pneumonia.—The study of a large series of cases in various hospitals reveals that in over 50 per cent there had been a cold or sore throat for several days before the onset of pneumonia.

Pulmonary Abscess.—This is a frequent result of nasal sepsis. The author reported 47 consecutive cases of pulmonary abscess, in which 32 had followed operations on the oro-nasal cavities. Lord, in an analysis of 227 cases, found abscess a sequel to tonsillectomy in 34.3 per cent of the cases.

Asthma.—When we place in one group those cases of allergic asthma due to pollens, feathers, and other epidermals, and food, there is still a large group in which no definite sensitiveness to protein can be demonstrated. A large proportion of this group will be found to have associated nasal disease. Four cases are cited to illustrate the relief secured from the removal of nasal infections, such as empyema of the antra and ethmoiditis.

Recurring Bronchitis.—In this large group of cases, chronic nasal infection is a common source of infection. Five cases are reported, illustrating relief from chronic bronchitis secured through the removal of nasal infection.

Bronchiectasis.—Clendenning has made the startling statement that in 150 cases of bronchiectasis, varying in severity, all were asso-

ciated with long-standing nasal infection. The author requests a rhinologic examination in all cases of bronchiectasis, finding in most of the cases an associated sinusitis, with a history of nasal infection or symptoms of long standing.

L. J. CARTER, M.D.

Pulmonary Manifestations of Lymphogranulomatosis. Erich Saupe. *Klin. Wchnschr.*, 1930, II, 1495-1499. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 602.

In ten cases the following conditions were found: (1) Direct extension of mediastinal tumors into the lung; (2) pulmonary foci separate from the mediastinum; (3) the disseminated type which may be accompanied by effusion. The diagnosis was from microscopic section rather than by roentgen examination. The differential diagnosis was chiefly between hilus carcinoma, with mediastinal metastasis, and tuberculosis. Roentgen therapy is effective in pulmonary as well as in glandular involvement.

H. C. OCHSNER, M.D.

Semeiology and Radiographic Diagnosis of Benign Anatomic-clinical States. Guillermo Bosco. *Prensa Med. Argentina*, June 10, 1931, XVIII, 46-55.

In this article, the author considers only lesions of the respiratory tract, primarily in connection with the differentiation of benign from malignant lesions. As is well known, any pathologic condition of the bronchi, alveoli, or pleura gives rise to anatomic alterations which cause a condensation in the organ. Such changes produce impressions on the X-ray plate which do not always make a diagnosis clear. Sometimes it is difficult to say whether the lesion is benign or malignant, particularly since X-ray findings and symptomatology are not considered simultaneously. Radiographs, however, can usually demonstrate the presence or absence of tumors.

The author goes into detail about several lesions, but the valuable point in the article is

that he presents the fact that benign lesions may appear anywhere in the lung but never in the mediastinum, because there is no respiratory tissue there, while malignant tumors are either attached or involve the mediastinum. So in a radiograph of the chest, this should always be the primary step in making a diagnosis.

N. G. GONZALEZ, M.D.

Roentgenologic Investigation of the Peristaltic Action of Human Bronchi. Seiichiro Mayeda. *Mitt. med. Ges. Tokio*, XLIII, 1703-1818, and *Deutsch. Zusammenfassung*, 1929, pp. 1703-1705. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 262.

In 213 cases of lipiodol injection of the bronchi, fluoroscopic and serio-roentgenographic examinations were made. There is a peristaltic and twisting wave-like motion, the origin being distal to the position of the contrast medium. Peristalsis starts immediately after injection. Changes in the peristalsis are due to variation of bronchial tonus. There is anti-peristalsis in bronchiectasis, noted especially at the orifices of the cavities. Peristalsis continues in all phases of respiration, in each systole the bronchi of the left lower lobe showing an increase in peristalsis. Peristalsis is activated by any vagus stimulant and inhibited by sympathetic stimulation.

H. C. OCHSNER, M.D.

CHEST (GENERAL)

Calcification of the Pleura. Gustav Velde and Walther Schlopsnies. *Röntgenpraxis*, July 15, 1931, III, 634-642.

Calcification of the pleura takes place by incrustation of the pleura with calcium salts, especially in the central, poorly vascularized portions of scars (dystrophic calcification, according to M. B. Schmidt); however, it may occasionally be found without marked pleural thickening. It represents the final outcome after an exudative pleuritis, an empyema, or a hemothorax. A general tendency of the body to deposit lime salts cannot be found in

such cases, in the authors' opinion. Such a calcification follows the primary disease usually by many years.

A diagnosis *in vivo* can only be made by a roentgenologic examination (fluoroscopy and roentgenogram). Extent, shape, and situation of such calcified areas in the pleura are variable. A differential diagnosis from intrapulmonary calcifications and rib-callus must be made. Interlobar calcifications sometimes are difficult to separate from other calcifications of the pleura. In 4,500 roentgenologic examinations of the chest, 8 cases of calcification of the pleura were seen. The relative frequency of such an occurrence is about 0.18 per cent. In 3 cases, an old injury of the thorax and in 2 cases, an old pleurisy were the etiologic factors. In 3 cases, there was no history of lung or pleural disease.

H. W. HEFKE, M.D.

Lateral X-ray of the Chest to Localize Intrathoracic Conditions. A. Jaubert de Beaujeu. *Jour. Radiol. et d'Electrol.*, March, 1931, XV, 129-140.

The author calls attention to the fact that, due to increased interest in the heart and blood vessels, the oblique instead of the true lateral radiograph of the chest is taken.

It is important to take a true lateral view to locate the exact pathologic process in the chest, as this is the only position which gives a view of the posterior and anterior mediastinum and the base of the lungs posteriorly. The article is well illustrated.

LESTER J. WILLIAMS, M.D.

CONTRAST MEDIA

Intravenous Pyelography by Intravenous Injections of Uroselectan and Pyelognost. Carlos Heuser. *Semana Méd.*, May 22, 1930, XXXVII, 1326-1331.

This method has been used very extensively in Germany, since 1928, and the author has been working on it to compare results. The

conclusions which he arrived at do not agree with those reported in Germany.

By injecting 3 grams of pyelognost in rabbits and taking films every 5, 10, 15, 20, 25, 30, 45, 60, 100, and 180 minutes, he has been able to obtain good visualization of kidneys and gall bladder at 25 and 30 minutes, though they showed faintly at 5 minutes. At 60 minutes, a good film of the bladder was obtained. Using smaller amounts of pyelognost—2 grams—the gall bladder did not show. With uroselectan, using varying doses of from 2 to 5 grams, the kidneys did not appear outlined in radiographs taken up to 5 hours after the injection, but the bladder showed well at one hour. On a patient injected with 30 grams of uroselectan in 80 c.c. of water, beautiful pyelograms were obtained at 5, 10, and 15 minutes. The author states that intravenous pyelography is indicated in persons who refuse to be cystoscoped and that uroselectan gives excellent results.

N. G. GONZALEZ, M.D.

A Rare Accident from Taking Capsules of Tetraiodophenolphthalein. Carlos Heuser. *Semana Méd.*, June 5, 1930, XXXVII, 1448, 1449.

Most of the accidents from this drug have been in either the stomach or intestine. The case herein presented is interesting in that it occurred somewhere else. A woman, 60 years of age, was advised to take tetraiodophenolphthalein capsules for the purpose of gall-bladder visualization, because she gave a history of gall-bladder stones. She was in bed when she took the first capsule, and believed that it went into her lungs. A few moments after swallowing it, she had severe pain in the throat, and could not talk; there was a feeling of constriction about the throat, and shortness of breath. In half an hour, she was improved, but the burning remained. The next day, she was examined, and edema of the vocal cords and a blue line in the larynx were found. Antero-posterior and lateral radiographs were made. In the latter, there was found a shadow extending from the fourth cervical vertebra to the insertion of the

first rib. The trachea was found anterior to the shadow.

The author concludes that the patient probably retained the capsule in her mouth for a while so that when she swallowed it, it broke. Thus some of the dye came in contact with the vocal cords, the rest going down the esophagus. The patient recovered in a few days' time.

N. G. GONZALEZ, M.D.

Intravenous Pyelography. Carlos Heuser. *Semana Méd.*, Jan. 29, 1931, XXXVIII, 327, 328.

The author has previously reported his findings on intravenous pyelography with uroselectan and pyelognost. Herein he presents those obtained with abrodil and "metafan." Abrodil can be given either intravenously or orally, but the latter method is not satisfactory because some of the abrodil remains in the intestine, marring the pyelogram. Other workers on this substance, such as Ziegler, Bronner, Hecht, and others, give 20 gm. of abrodil in 120 c.c. of water, but the author has been able to obtain beautiful pyelograms twenty minutes after injecting with 10 gm. only. The dye appears in the urine a few minutes after the injection and continues to be excreted for only three hours. The dye can also be given rectally in 20 gm. doses with very good results.

N. G. GONZALEZ, M.D.

CYST (HYDATID)

Hydatid Cyst. Rodolfo Dassen and J. C. Rey. *Semana Méd.*, April 10, 1930, XXXVII, 921-926.

This case is here presented because of the rarity of the condition. A woman, 29 years old, developed a burning sensation in the right hypochondrium a week after parturition. This condition lasted three months and disappeared. Four months later, it reappeared, being accompanied by a persistent cough and a left-sided flaccid paraplegia. At this stage, she was

referred to the authors who, clinically, found a mass in the right chest which, by exclusion, they diagnosed as hydatid cyst causing pressure of the cord. X-ray examination showed a non-homogeneous shadow on the right side, which seemed to be pushing the seventh and eighth ribs aside and compressing the cord at about the ninth dorsal segment. The final diagnosis of right extrapleural hydatid cyst compressing the cord was made. Resection of the seventh and eighth ribs was resorted to and the cyst removed. All the symptoms mentioned above disappeared gradually and the patient recovered.

The authors conclude that, whenever any pressure paraplegia is present and the cause cannot be ascertained, hydatid cyst must be kept in mind.

N. G. GONZALEZ, M.D.

DIATHERMY

Bipolar Coagulation of Chronic Endocervicitis. Thomas H. Cherry. *Med. Herald, Phys. Ther., and Endocrine Survey*, July, 1931, L, 288-290.

The author believes that coagulation by diathermy is the method of choice in treating chronic endocervicitis. This procedure does not require hospitalization, although the lesion is not healed until from four to six weeks have elapsed. The technic of using the two electrodes in the cervix is described in detail. The author prefers this method, because the depth of the coagulation in the cervical canal is more easily controlled than with the monopolar method.

WILLIS S. PECK, M.D.

Treatment of Gonococcal Infections by Diathermy. E. P. Cumberbatch. *Am. Jour. Phys. Ther.*, July, 1931, VIII, 97-102.

The author advises the application of diathermy to the foci in cases of gonococcal arthritis instead of applying it to the involved joints. The prostate and seminal vesicles are

the principal locations in the male, and the urethra and cervix in the female. A detailed description is given of each technical application. The author reports cure of the gonococcal arthritis in the fifty-two cases which were treated. Some of these, however, had permanent structural changes. Gonococcal orchitis and epididymitis yielded rapidly and satisfactorily to diathermy treatment. Gonococcal salpingitis, where no pus or pent-up fluid was present, was symptomatically relieved.

WILLIS S. PECK, M.D.

DOSAGE

Action of X-rays on Tissue Cultures *in vitro*. L. Doljanski, J.-J. Trillat, and Le-comte du Noüy. *Compt. rend. Acad. Sci. Paris*, 1930, CXC, 1147-1150. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 247.

Pure cultures of fibroblasts were subjected to unfiltered radiation at 28 P.K.V., 30 ma., and F.S.D. 4 cm., and studied at from 12 to 24 and 48 hours after irradiation. By increasing the dose, the latent period was shortened. Irradiation of one minute produced definite damage, the lethal dose being five minutes. The effect was on the tissue itself, not on the culture medium, for irradiation of the solution alone produced no effect.

H. C. OCHSNER, M.D.

Divided Dosage in Radium Therapy. Albert Eidinow and J. C. Mottram. *The Lancet*, June 6, 1931, CCXX, 1236-1238.

The authors have found that fewer milligram-hours are required to produce an erythema when the intensity of radiation is high than when it is low. Intensity of a few milligrams per centimeter exposure extending over several weeks will not produce an erythema. Similar results were obtained with a strong applicator by giving a number of small doses once daily or once a week.

Working with Jensen's rat sarcoma, experiments were conducted to determine its reaction to divided doses. Tables giving skin re-

actions show the difference between single and divided doses, and figures show the results of divided and single doses from the following experiments: Two tumors measuring 60 square millimeters were taken. One received fifteen hours gamma-radiation. The second received three exposures of five hours at two-day intervals. Both disappeared at approximately the same time. Three tumors of 20 square millimeters were similarly treated. The tumor receiving the divided dosage disappeared more rapidly than the tumors receiving one dose. Five more tumors were dealt with using twelve hours and three periods of four hours each. One tumor receiving twelve hours in one dose after retarded development grew into a larger tumor. A second twelve-hour radiated tumor persisted for a longer period than the tumors receiving divided doses. Other series of radiation were similar to those described.

Conclusions are drawn that Jensen's rat sarcoma is as sensitive to divided doses as to a single dose within the limits of the experiments, and that the overlying skin receives less injury from radiation of a tumor with a view of causing its disappearance. A much larger dose of radiation can be set free in a tumor without production of skin erythema by divided doses than by a single exposure. The authors suggest that in application of radium or X-ray in treatment of tumors, divided doses should be given a thorough trial, but the optimum time interval and size of dose can be discovered only by clinical research.

H. J. ULLMANN, M.D.

EXPERIMENTAL STUDIES

Therapeutic Application of the Antagonism of Various Types of Irradiation. Lodovico Armani. *Riv. Radiol. e Fisica Med.*, 1930, II, 211-219. Abstracted in *Zentralbl. f. d. Ges. Radiol.*, Sept. 19, 1930, IX, 246.

This is a report of further studies on the antagonism between visible infra-red and roentgen rays on the seeds of *Pisum sativum*. Roentgen-irradiated Sabouraud-Noiré tablets were changed from Tint A to Tint B in 10

minutes, by infra-red irradiation, while this was accomplished by ultra-violet in 22 minutes, and by diffuse daylight in 240 minutes. In animal experimentation it was found that animals subjected to lethal doses of X-ray survived if the X-ray was followed immediately by infra-red irradiation. After a roentgen skin injury, one part of the injured skin was subjected to infra-red, which region healed quickly in contrast to the unirradiated part. In several cases of carcinoma, the author used two to three H.E.D. of X-ray, followed immediately by infra-red. The only skin effect was an extensive pigmentation.

H. C. OCHSNER, M.D.

An Experimental Study of the Relative Intensities of X-ray Lines in the Tantalum L-spectrum. Victor Hicks. *Phys. Rev.*, 1930, XXXVI, 1273-1284.

The relative intensities of seventeen lines in the L-spectrum of Ta have been investigated by the ionization spectrometer. Intensity results are given.

CHEMICAL ABSTRACTS.

The Rachitic Factor in the Development of Tumors. A. H. Roffo. *Prensa Med. Argentina*, June 10, 1931, XVIII, 57-63.

The author has worked for many years on the relation of diet to growth of tumors. He believes that nutrition, if not the cause, at least plays a very important rôle in the growth of tumors. He points out the fact that tumors are rich in lipoidal substances and that in certain races, such as the Vasques and Irish, who eat food containing large amounts of lipoids, cancer is very frequent.

In this particular article, he presents his findings—including radiographs—of the rachitic diet on rats. To thirty rats he gave a normal diet, and to another thirty he gave polished rice only. The first number grew normally to an average of from 150 to 180 grams, while the second group attained only from 40

to 50 grams. Radiographs taken showed convincing evidence of rickets in the latter. The transmission of tumor (sarcoma and carcinoma) was made to both normal and rachitic rats. The results were that both these tumors were much larger in the animals with normal diet. The weight of the sarcoma in those with normal diet was from 45 to 50 grams, while in the rachitic ones, it was from 1.10 to 3 grams. The carcinoma weighed about 23 grams for the first group and 1.5 grams for the second group. It is also interesting to note that sarcoma occurred in 100 per cent of the normal rats and in only 80 per cent of the rachitic ones, while carcinoma occurred in 75 per cent of the former and 25 per cent of the latter.

N. G. GONZALEZ, M.D.

Gland Extracts in Experimental Carcinoma and Sarcoma of Albino Rats. O. M. Gruhzit. *Ann. Int. Med.*, June, 1931, IV, 1589-1597.

A series of albino rats were inoculated with Flexner-Jobling carcinoma or Jensen sarcoma of rats. When the tumor reached about one square centimeter in size, the animals were divided into three groups and treated. One group was treated with the suprarenal cortex hormone extract, the second group was an untreated control group, and the third group was treated with an extract of ox testis as a control for non-specific protein effect.

The extracts were given subcutaneously on the side opposite the tumor. Six daily injections were given weekly in maximum tolerated doses. On the death of the animal, careful autopsies were made, and in the absence of visible tumor tissue, microscopic examinations were made of the fixed tissues.

Methods of preparation of extracts are given and dosages stated. The results are shown by graphs, and the work is summarized as follows:

1. Albino rats inoculated with Flexner-Jobling carcinoma, when treated with suprarenal cortex substance extracts, showed neither a delay in the growth of the tumors nor their

regression, as compared with the control group or those treated with non-specific protein.

2. The treatment with thymus extract neither inhibited the growth nor produced regression. Injection of the extract did not prolong the life of the tumor-bearing animals.

3. The suprarenal cortex extracts, the thymus, the omentum-lipoid, and the ox testis extracts neither inhibited growth nor caused regression of the Jensen sarcoma.

4. The rate of ulceration of carcinomatous tumors under treatment with various gland extracts was not greater, as compared with the rate of ulceration of other rats treated with inorganic salts or non-specific protein.

5. The organic extracts studied in experimental carcinoma and sarcoma in rats had no beneficial effect in inhibiting growth of the tumors or their regression, nor did the extracts cause prolongation of the life of tumor-bearing animals, as compared with untreated ones or those treated with non-specific protein extracts.

CHARLES H. DEWITT, M.D.

X-ray Studies of Motility of Gastro-intestinal Tract of Rachitic Rats with Healed Bone Lesions. Leon J. Menville, J. N. Ané, and S. N. Blackberg. *Proc. Soc. Exper. Biol. and Med.*, June, 1931, XXVIII, 932, 933.

The authors made comparative studies of the gastro-intestinal motility of rachitic rats to ascertain whether the motility returned to normal after the bone lesions of the rats were healed.

Preliminary examinations of the gastro-intestinal tract of the rachitic rats with typical bone changes revealed a definite hypomotility in every case. Subsequently each of the animals was given five drops of Viosterol per day, in addition to the original rachitic diet. After a period of ten days, roentgen examination showed that the bone lesions of all the rats were healed, but that the hypomotility previously observed was still in evidence.

J. N. ANÉ, M.D.

GALL BLADDER (NORMAL AND PATHOLOGIC)

Gall-bladder Function. Editorial. *Jour. Am. Med. Assn.*, July 11, 1931, XCVII, 105.

From the results of experiments on various species of animals, Mann estimated that the capacity of the gall bladder was usually less than the amount of bile secreted in half an hour. There is an enormous concentration of bile during its sojourn in the organ.

The evidence is quite conclusive that the gall bladder never completely empties at one time. Ravdin and Morrison favor the conclusion that, although certain constituents of the bile may leave the gall bladder by the lymphatics or the blood vessels, concentrated bile is discharged through the cystic duct as a result of contraction of the gall bladder itself.

C. G. SUTHERLAND, M.B.(Tor.).

GASTRO-INTESTINAL TRACT (DIAGNOSIS)

Some Recent Developments in the Radiologic Examination of the Gastro-intestinal Tract. John O'Sullivan. *Med. Jour. Australia*, June 6, 1931, I, 685-690.

This paper emphasizes the value of radiologic visualization of mucosal changes based on the technics of Forssell, Berg, and Knothe. The white-washing effect delineating the mucosa is obtained by using small quantities of barium mixture, preceded in some cases by gastric lavage.

In the esophagus the diagnosis between cardiospasm, carcinoma, and diverticulum is facilitated. Cardiospasm often shows continuity of the mucosal folds in the region of the cardia.

In atrophic gastritis the mucosal folds are flattened, narrowed, or obliterated, while in the hypertrophic type the mucous membrane is swollen and may show polypoid changes. In the neighborhood of gastric ulcers and carcinomas a wart-like granular surface of the mucosa is often seen.

Convergence of the mucosal folds towards

the crater of a gastric ulcer is familiar. Symptoms of gastric ulcer will persist after the ulcer niche has disappeared, so long as there is any mucosal change. The present technic, however, fails to demonstrate an acute hemorrhagic ulcer, as there is no swollen mucosal wall around these lesions. Early neoplasms of the stomach are to be suspected when there is a persistent transverse fold in the normally longitudinally arranged folds of the antrum, or when there is a sudden breaking off of a fold, but these appearances must be persistent.

The actual lesion in duodenal ulcer can be demonstrated by the thickness and swelling of the mucosa. In the large intestine Fischer's method of introducing into the bowel a small amount of barium mixture followed by cautious filling with air facilitates the diagnosis of diverticula, polypoid degeneration, and spastic and organic stricture. In conditions such as colitis, dysentery, and spastic colon, the fine mucous membrane network is replaced by an irregular granular appearance, or the folds may show abnormal prominence.

Excellent photographs exemplifying most of the above appearances accompany the text, but to the technic the author adds nothing new.

J. G. STEPHENS, M.D.

Hyperplastic Gastritis. G. A. Weltz. Röntgenpraxis, July 1, 1931, III, 577-580.

The pathologic-anatomical picture as well as the clinical picture of gastritis is very variable. Many questions about the etiology, symptomatology, and clinical findings are still unsettled. According to Konjetzny, the gastritis is the most important factor in the genesis of ulcers. A case with a very extensive hyperplastic gastritis is described.

For about fifteen years, the patient, 53 years old, complained of gastric symptoms consisting of epigastric pain after meals, vomiting occasionally, and loss of weight and strength. Roentgenologic examination showed an absence of normal mucosa; in its place thick and wide folds were seen, especially in the antrum and on the greater curvature side. The ex-

tent of the changes is greater than in any case published, as the author states. The hyperplastic type has remained about the same during two years.

H. W. HEFKE, M.D.

Clinical Study of a Case of Gastric Tumor by Combined Method of Abdominal Palpation and Gastric Sound. Arturo J. Heidenreich and Guillermo L. Heidenreich. Prensa Med. Argentina, June 20, 1931, XVIII, 79-86.

The case here presented gives a clinical history which must be divided into two parts, the first part consisting of a typical history of gastric ulcer of ten years' duration, and the second of an abdominal tumor of three months' duration. The symptoms of the latter were, briefly, rapid loss of weight, pain in the epigastrium, which was augmented by food, and the presence of a mass in the upper abdomen at the midline. For diagnosis, a gastric sound was passed, and it was found that both the mass and the sound were felt moving synchronously in the same direction on respiration, change of position, or on pressure.

The other clinical findings pointed toward a gastric tumor and also another tumor, probably at the head of the pancreas. A radiograph confirmed the presence of a double tumor, the first at the pylorus, and the second at the head of the pancreas. As the operation was performed under local anesthesia, it was possible to see, when the patient was asked to take a deep breath, that the tumor moved with respiration, just as palpated before operation. The tumor was found to arise from the posterior wall of the stomach and to invade the head of the pancreas.

N. G. GONZALEZ, M.D.

Chronic Syphilitic (?) Gastritis with Total Gastrectomy and Pernicious Anemia. Allan K. Poole and Lewis C. Foster. Jour. Am. Med. Assn., June 27, 1931, XCVI, 2187-2190.

This is a case report of a patient showing marked emaciation and dehydration. A roent-

genogram revealed the stomach to be small and well to the left of the median line, with persistent hour-glass deformity but no gastric residue. At operation, the gross appearance was that of a linitis plastica, and a total gastrectomy was done. The pathologic diagnosis was gastric granuloma, probably syphilitic.

Five and a half years after operation the patient was living, and appeared to be in good physical condition, except for a marked anemia—noted after the five-year period—which was controlled by intravenous aqueous liver extract and later desiccated hog stomach. This anemia apparently occurs in all gastrectomized patients who live long enough.

C. G. SUTHERLAND, M.B.(Tor.).

The Roentgenologic Appearance of the Normal and Pathologic Relief of the Esophagus. R. Schatzki. Röntgenpraxis, June 15, 1931, III, 529-541.

The roentgenologic examination of the esophagus has been more or less a relief examination, due to the narrow canal and the rapid emptying. Systematic examination of the surface of the esophageal mucosa with a thin layer of contrast medium leads to a better and more minute diagnosis. The barium must be given in a rather thick paste, a better demonstration of the mucosa sometimes being obtained by placing the patient in a horizontal position.

The normal esophagus shows narrow longitudinal folds in its entire course; however, in cachectic individuals these folds might be definitely narrowed. Inflammatory changes are evidenced by a marked widening of the mucosal folds. The demonstration of this pathologic change is important not only in the rather infrequently encountered esophagitis, but more so as complication in diverticula, esophageal hernias, and peptic ulcers of the esophagus. The esophagitis may cause the main clinical symptoms (pain, hemorrhage) and may by its demonstration lead to further search for the primary disease.

A case is described in which the complicating esophagitis, which was demonstrated

roentgenologically, helped in finding a small peptic ulcer of the esophagus. The roentgenologic demonstration of esophageal varicosities is possible, a somewhat thinner barium mixture being advised in these cases. The mucosal examination is of great value for the diagnosis of a carcinoma, its extent, and localization, for the demonstration of ulcerative processes, for the differential diagnosis between benign stricture and malignancy, and especially for early diagnosis of a cancer.

H. W. HEFKE, M.D.

Gastric Hyperacidity (?). Editorial. Jour. Am. Med. Assn., June 27, 1931, XCVI, 2199.

Textbooks of to-day tend to identify hyperacidity with hypersecretion, admitting that it is brought about not by concentration of the gastric juice but by production of a larger volume of fluid. Hyperacidity, or hyperchlorhydria, thus becomes identical with hypersecretion after ingestion of food. It might be assumed that "pure" gastric juice could readily be obtained by the use of a stomach tube. All such mechanical devices are likely, however, to promote a production of mucus which will combine with the acid and alter the gastric acidity.

Hollander and Cogwill appear to have mastered the difficulties in experimental animals by collecting the secretion from isolated gastric pouches without any irritation or contamination. It is clear from their convincing data that variations in the rate of secretion are not of necessity accompanied by corresponding changes in acidity.

The hypothesis regarding the constant acidity of the secretion of the parietal cells seems now to be dropped from clinical nomenclature.

C. G. SUTHERLAND, M.B.(Tor.).

Routine Radiograms for Investigation of Intestinal Obstruction. E. T. C. Milligan and George Simon. British Med. Jour., June 27, 1931, No. 3677, p. 1114.

Localization of the site of intestinal obstruction for its relief before operation facilitates

the surgeon's task, and so is of incalculable advantage to the patient. Opaque meal and enema given for X-ray investigations in these cases are, however, too great a source of peril to be practicable, and we must look to some other method.

The authors have found that invaluable information in cases of intestinal obstruction, paralytic and organic, in the small or large gut, is obtained by a routine simple radiogram of the distended abdomen before operation, without the aid of opaque substances (barium enema or meal) and without preparation of any kind. Imprisoned gases outline with striking definition the position, size, and extent of the distended bowel on an X-ray film, the distended large gut being readily distinguished from the small intestine. The gas-filled cecum stands out prominently and characteristically. The site of obstruction in the large bowel is marked by an abrupt ending of the gas-distended bowel. The contracted bowel, empty of gas, below the obstruction, is not apparent on the film, thus lending striking definition to the place of obstruction.

In the X-ray technic, the Potter-Bucky diaphragm is essential, and very gentle compression helps to steady the parts. A soft ray, produced by not more than 75 K.V.P., will bring out the translucent gas areas to the best advantage, while a sufficient milliamperage should be used to enable the exposure to be made in less than four seconds, as the patient is usually too ill to hold his breath any longer.

Six illustrative radiograms are reproduced.

W. D. MACKENZIE, M.D.

GENITO-URINARY TRACT (DIAGNOSIS)

Reflux Pelvic Lavage. Seymour F. Wilhelm. *Jour. Urol.*, August, 1931, XXVI, 247-251.

A case of post-partum bilateral pyoureter (ureterectasia) and pyonephrosis with high blood nitrogen figures was treated daily by reflux pelvic lavage with gratifying results. Re-

flux pelvic lavage is a simple therapeutic procedure, applicable to cases of pyoureter and pyonephrosis where reflux can be demonstrated by cystographic examination. Illustrative pyelocysto-ureterograms accompany the article.

DAVIS H. PARDOLL, M.D.

A Simple Device for Serial Pyeloureterograms. Thomas D. Moore. *Jour. Urol.*, August, 1931, XXVI, 317-323.

The many advantages of serial pyeloureterograms are well known; their importance has recently been emphasized by Jarre and Cumming. They not only reveal the physiologic variations in the contour of the calices, pelvis, and ureter, but may afford an accurate determination of the emptying time of the kidney and ureter. The method of pyeloscopy, as employed by Legueu, is impractical in persons of more than average weight; furthermore, visualization of the detail of such structures as the ureter and minor calices is often inadequate.

The author has constructed a modification of the usual Bucky diaphragm tray, with which three pyelograms may be made in rapid sequence on a standard size film. The details of this method are described in the writer's article.

With this apparatus, it is possible to obtain three well-filled pyeloureterograms within the space of a few seconds. A minimum of time is lost in springing the Bucky and pulling the cassette to a new position by means of a special handle.

A more accurate spacing of exposures for visualization of the emptying time of the kidney is permitted by this device. If two cassettes are used, six pyelograms may be obtained on two standard size films.

The first pyeloureterogram is made after a complete exhalation, the second at the end of inspiration, and the third at the end of a second exhalation. In this way, the respiratory excursion of the kidney is revealed. By this method, also, physiologic kinks in the upper ureter are often observed following a deep

breath, thus confirming the recent observation of Thompson and Bumpus.

This modified tray is inexpensive and, with only a slight alteration, is adaptable to most of the standard Bucky diaphragms now on the market.

Several illustrations accompany the paper.

DAVIS H. PARDOLL, M.D.

Partial Resection for Unilateral Reduplication of Pelvis and Ureter. Samuel Lubash. *Am. Jour. Surg.*, July, 1931, XIII, 91-95.

A case of reduplication of the ureter which fused just above the bladder is reported. Pyeloureterography revealed the ureter from the upper segment crossing the ureter from the lower segment at its pelvic junction and causing intermittent hydronephrosis with its accompanying sequelæ. Resection of the upper segment was performed, with marked success and restoration of function in the lower obstructed segment, as evidenced by subsequent pyelography on the resected kidney.

DAVIS H. PARDOLL, M.D.

Diverticulum of the Ureter: A Report of Three Cases. Henry G. Bugbee. *Jour. Urol.*, August, 1931, XXVI, 215-227.

A review of the literature on the subject reveals the fact that diverticulum of the ureter is a rare clinical and anatomic finding. It has been produced experimentally. In four instances, the lesion has been found at autopsy, and seven clinical cases have been reported, to which the writer adds three more.

Pain on the side of the lesion is a predominant symptom. Also, frequency of urination and dysuria were noted in nine of the cases, hematuria occurring in one instance.

Etiology is either congenital or acquired. A congenitally narrow ureteral meatus or an attempt at reduplication of the ureter may produce this condition. When acquired, the origin may be traced to some form of obstruction to urinary excretion, with subsequent dilatation and outpouchings of the ureteral wall.

With the advent of intravenous urography,

it is possible that diverticula of the ureter will be discovered more frequently. Soft, pliable catheters are liable to encounter a diverticulum by being obstructed in their passage, or to demonstrate its presence by coiling up in the diverticulum. The diagnosis may be verified by a ureterogram.

Several illustrations accompany the article.

DAVIS H. PARDOLL, M.D.

Renal and Ureteral Calculi: Some Present-day Surgical Problems. H. G. Hamer. *Am. Jour. Surg.*, July, 1931, XIII, 96-107.

The paper may be summarized as follows: Delayed passage of small ureteral calculi may often be facilitated by ureteral instrumentation, either with the ureteral catheter or bougie or specially devised instruments. Such manipulations are not wholly without danger.

The migrating ureteral calculus is always a cause for worry, being capable of seriously frustrating efforts for its removal.

Calculi of unusual size lodged in the lower ureter frequently require operative removal, either by ureterolithotomy or ureteral meatotomy. Ureteral meatotomy by surgical diathermy is preferable to that by incision.

All urologists recognize that bilateral renal calculi usually manifest a state of advanced renal infection, seldom of the same duration in the two kidneys, hence an unequal degree of renal impairment, and present problems that demand the exercise of trained judgment in the adoption of a program of surgical interference.

Calculus in the solitary kidney is cause for apprehension, the risk of operation being dependent upon the function and the degree of infection.

The combination of stone and renal tuberculosis is rare, and it may be inferred that in such instances the stone is the primary lesion.

Difficulty of diagnosis of renal and ureteral stones by X-ray is most common when the stones are very small, and especially when composed of uric acid. Cystine stones are sometimes transparent to X-ray. The urogram will often make visible a stone transpar-

ent to unaided X-ray. The "staining" quality of certain media, such as sodium bromide, sodium iodide, uroselectan, and skiadan, has been found helpful.

Extrarenal shadows may usually be differentiated by the lateral X-ray and pyelogram and stereoscopy.

Six interesting cases are reported in detail.

DAVIS H. PARDOLL, M.D.

Inflammatory Obstruction of the Ureter, Caused by Psoas Abscess, Secondary to Tuberculosis of the Spine. Gilbert J. Thomas and Thomas J. Kinsella. *Am. Jour. Surg.*, July, 1931, XIII, 72-74.

The authors report two cases of ureteral obstruction due to psoas abscess. Hydronephrosis and destruction of the kidney resulted from the constriction of the ureter. This condition was not associated with tuberculosis of the kidney. The urinary findings were negative. Also, the history was of no value in enabling one to arrive at a diagnosis of ureteral obstruction.

The possibility of obstruction of the ureter in all cases of psoas abscess should be considered.

DAVIS H. PARDOLL, M.D.

Pyeloscopy: A Diagnostic Procedure which Promises to Inaugurate a New Era in the Recognition and Satisfactory Treatment of Painful Abnormal Motility Syndromes of the Upper Urinary Tract. William P. Herbst. *Jour. Urol.*, August, 1931, XXVI, 233-239.

Pyeloscopy preliminary to pyeloureterography will eliminate re-cystoscopy for patients who have been unfortunate enough to have unsatisfactory urograms as a result of filling technic difficulties. Manges was the first one to suggest the use of pyeloscopy, in 1918. He had employed this method of examination since 1912.

The action of atropin, eserine, morphine, strychnine, pituitrin, and ergot on the motility of the upper urinary tract, as observed by pyeloscopy, is a distinct contribution to the pharmacologic action of drugs.

There are definite renal, pain-producing, abnormal motility syndromes which can be recognized by pyeloscopy and satisfactorily relieved by eserine or sympathectomy.

The complete cycle of urinary expulsion from the minor calices to the bladder is illustrated graphically as observed by pyeloscopy.

Further observation, together with the assimilation of medical and surgical data, promises a new era of success in the treatment of renal pain syndromes which have heretofore been the source of much grief to both patient and doctor.

DAVIS H. PARDOLL, M.D.

Prostatic Stone Causing Pseudodiverticulum of the Posterior Urethra. J. S. Eisenstaedt and T. G. McDougall. *Jour. Urol.*, June, 1931, XXV, 639-648.

A prostatic stone, which by increase in size produced a pseudodiverticulum of the urethra, is reported. Stones of this type have been described as urethral diverticular stones, which is misleading. True prostatic stones are always multiple and have as a nucleus organic material which is the corpora amylacea. The etiology of prostatic calculi is not well understood, but they are often associated with other genito-urinary pathology. The X-ray is the most important diagnostic aid. Treatment by perineal prostatotomy is the method of choice, even when the stone communicates with the urethra.

DAVIS H. PARDOLL, M.D.

Aberrant Renal Vessels in Children. George M. Fister and Eugene H. Smith. *Jour. Urol.*, August, 1931, XXVI, 175-187.

Although accessory renal vessels are common and ureteral obstruction is present in 2 per cent of all children, the association of the two is uncommon.

The following symptoms make the diagnosis of aberrant renal vessels probable: (a) Repeated attacks of pyelitis; (b) no calculi; (c) intermittent attacks of renal colic; (d) ureters normally catheterized; (e) micturition normal; (f) pyelographic evidence of dilation

of the kidney pelvis with a ureteral kink, or narrowing of the upper ureter; (g) a V-shaped retraction of the ureteral orifice as seen through the examining cystoscope may be a help in the diagnosis. This change suggests tension on the ureter with retraction of the orifice. A palpable, soft kidney tumor is demonstrable in most cases.

Having shown a ureteral obstruction, the question arises, Is it intra-ureteral in origin or extra-ureteral? A pyeloureterogram will often differentiate between the two forms of obstruction.

The treatment of hydronephrosis associated with anomalous vessels is in most cases surgical. Conservative surgery is indicated early enough before irreparable renal damage has occurred. Re-establishment of free urinary drainage with freeing of adhesions, divisions of bands, nephropexy, and other plastic procedures may be necessary in order to restore proper function.

DAVIS H. PARDOLL, M.D.

Possible Errors in the Interpretation of Intravenous Urography. Davis H. Pardoll and R. A. Lifvendahl. *Illinois Med. Jour.*, July, 1931, LX, 74-76.

Further evaluation and observation are essential in order to attain a greater degree of accuracy in the interpretation of intravenous urographs.

The authors report a case in which uroselectan, intravenously, failed to demonstrate either function or anatomical outline in a kidney which was found on operation to be perfectly normal. This case definitely demonstrates that the absence of visualization does not necessarily imply a pathologic kidney, reflex inhibition, or the absence of a kidney. The patient had a papillary carcinoma of the bladder, which was shown by the cystogram after uroselectan.

The authors, not seeking to detract from the value of intravenous urography, recognize its great value as a diagnostic agent, but call at-

tention to the possibility of erroneous interpretations.

CHARLES H. DEWITT, M.D.

GENITO-URINARY TRACT (THERAPY)

Post-operative Care of Urologic Cases. Henry G. Bugbee. *Am. Jour. Surg.*, July, 1931, XIII, 15-28.

The successful handling of a urologic surgical case is directly dependent upon an accurate diagnosis, thorough preparation of the patient for operation, a well conceived and executed operative technic, and intelligent post-operative care.

Cystoscopy, X-rays, urography, and intravenous urography have aided us materially in our accuracy of diagnosis.

The operative technic should aim towards elimination of pathology and restoration of function. Free drainage, forced elimination, control of hemorrhage, and stabilization of circulation should be sought after in our post-operative case.

Urologic surgical cases most commonly encountered may be grouped as follows: (1) Cases of prostate obstruction; (2) lithiasis; (3) tuberculosis, and (4) malignancy.

In the first group, the writer emphasizes the importance of pre-operative preparation, on which too much stress cannot be laid. Preliminary cystotomy and vas ligation help considerably in the successful management of the subsequent prostatectomy. Post-operative complications and treatment are taken into careful consideration.

One should check frequently with the use of X-rays all cases of urinary lithiasis. Emphasis is laid upon removal of all obstruction, elimination of infection, both local and focal, conservatism of modern surgical measures, with restoration of function wherever possible. Diet and medication in these cases are also of importance.

Tuberculosis of the genito-urinary tract is generally conceded to be secondary to a tuberculous focus elsewhere in the body. Both

pre-operative and post-operative care consist of general hygiene and tonic measures to increase the patient's resistance and lessen the activity of the acute lesion. Observation is continued for an indefinite period after the operation the better to detect any residuum of the infection.

The post-operative care of malignancy may be summed up in the words "eternal vigilance." Whether the operation be a radical removal of the tumor, if fortunately diagnosed at an early stage, or whether the growth be treated by radium, diathermy, or deep radiation, in an attempt to destroy or control it, the future of the case depends upon regularly repeated observations. Only by such post-operative care can the various methods of treating malignancy be evaluated. Post-operatively, the X-ray may be employed to demonstrate the position and number of radium seeds. In conjunction with other urologic examinations, the progress of the case may be observed. Further radium treatment may not be indicated by these procedures. In this manner, much may be accomplished. Early recurrences may be detected cystoscopically. These respond more favorably and more rapidly to fulguration than do the primary growths, especially after radiation, and they may often be eradicated if discovered in their incipency. Here deep radiotherapy and radium are valuable adjuncts, often advantageously applied together. Results will be in direct proportion to the time at which the growths are detected and treated.

Cases of bladder tumor should return for observation every month after operation. Later, not more than six months should elapse before re-examination, for a period of five years.

Renal tumor patients should be examined regularly for the presence of metastases or recurrences. Deep radiotherapy of the kidney region may be beneficial in inhibiting local recurrence.

In all cases of tumor of the testicle, deep radiotherapy should be applied to the wound region, inguinal, and renal regions, after the removal of the growth. Some observers advise radiotherapy before as well as after operation.

The intimate connection of surgical lesions of the urinary tract with the remainder of the body, such as prostatic obstruction with kidney function and the circulatory system; tuberculosis with tuberculous lesions in other parts of the body; lithiasis with the various body functions and focal infections, and malignancy with metastases, render a study of the whole body imperative, and a proper restoration of function and health, with a maintenance of the same dependent upon a carry-through. This means the utilization of every means of post-operative treatment and continued observation over long periods of time, with the employment of suitable measures at a time when recurrences of pathology are detected in their incipency and may be eradicated.

In no other class of cases is this follow-through of more importance, and the urologist holds no claim to results until the patient has been placed upon his feet, free from complications, and has passed the probable period of relapses and recurrences.

The discussions which followed Bugbee's paper were exceedingly interesting. Most of the doctors were in accord with his résumé of the proper pre-operative preparation, surgical technic, and post-operative care. There were, however, a few problems in which some of the speakers propounded their own viewpoints and experiences.

B. S. Barringer laid stress upon carcinomatous conditions of the prostate and bladder. He is an ardent advocate of radium, radium emanation, and roentgenotherapy in these cases.

Edwin Beer stated that in the study of X-ray treatment of tumors, whether they be primary tumors or recurrences, whether they be renal or bladder, he had failed to see any results. He advocates radical extensive surgery wherever possible in tumors of the upper genito-urinary tract. In carcinoma of the prostate, X-ray occasionally seems to benefit some patients, though the evidence is not absolutely clear. In connection with tumor of the testicle, the results seem to be in favor of X-ray treatment of the original tumor prior to operation.

F. W. Bishop emphasized the importance of maintaining an efficient cardiovascular system and proper intestinal elimination.

N. P. Rathbun discussed post-operative hemorrhage; preliminary ligation of the vas, as a preventative of epididymitis, and toxic psychosis. In carcinoma of the prostate, he advocates suprapubic cystotomy. He also employs radium, either through the bladder or through the perineum.

Oswald S. Lowsley made a few interesting remarks relative to urinary lithiasis. By changing the reaction of the urine to acid from alkaline and keeping it changed, no recurrence of lithiasis occurred in a patient who previously had had several remissions of this condition.

This is a very interesting paper and should be read by all interested in these urologic problems, the discussions by some of the eminent leaders in this field being particularly worthy of consideration.

DAVIS H. PARDOLL, M.D.

Hydronephrosis with Aberrant Polar Vessels: Report of a Case. Horatio N. Dorman. *Jour. Urol.*, July, 1931, XXVI, 121-130.

The author presents a case of hydronephrosis, due to aberrant vessels. At operation these anomalous renal vessels were ligated and nephropexy performed. The pain was relieved and the position of the kidney somewhat improved, with a slight reduction in the capacity of the renal pelvis. The function was increased to equal that of the unaffected side, while the infection which had been present was cleared up, as demonstrated by two subsequent sterile cultures.

DAVIS H. PARDOLL, M.D.

GYNECOLOGY AND OBSTETRICS

Pruritus of the Vulva. Juan Luis Sardi. *Rev. Méd. Cubana*, August, 1931, XLII, 956-970.

The writer introduces in this article a good outline of the different types of pruritus of the vulva, paying particular attention to the diag-

nosis, since that is essential for adequate treatment. He goes into detail concerning each type. In outlining the treatment, he considers weak radio-active substances. Bayet has obtained very good results with Becquerel's rays. In Vienna, they report excellent results from beta rays. The author has used torik-erine in the form of a salve, applied locally, on 12 cases, obtaining a permanent cure in 10, improvement in one, and no change in the other. His best results have been on pruritus of diabetic origin. He has not used X-rays or radium but reviews the literature and concludes that the results appear to be very good. He refers to the Breslau Clinic statement that X-rays constitute the elective treatment in such cases and reports 60 per cent cure and 100 per cent improvement.

N. G. GONZALEZ, M.D.

Factors in and Causes of Fetal, Newly Born, and Maternal Morbidity and Mortality. Hugo Ehrenfest. *Am. Jour. Obst. and Gynec.*, June, 1931, XXI, 867-880.

This is a comprehensive report. Only the portions of interest to radiologists will be abstracted.

Cancer is one of the rarer complications in pregnancy. If in a state in which cure seems possible, the disease should be treated without any consideration of the pregnancy. When the malignancy is advanced, treatment must be given with the thought of saving the child. A patient seemingly cured of a malignant disease should not be permitted to go through a pregnancy.

The author states that many women suffering from myeloid leukemia have been known to pass through two and even more labors. Interruption cannot be expected to prove useful, since any operation on a leukemic patient admittedly implies considerable risks. These women should be warned against becoming pregnant, but if they do conceive, it is probably better to let the pregnancy go to a termination.

The author states that it has been demonstrated beyond all reasonable doubt that pre-conceptional irradiation is harmless as far as

the future child is concerned. In contrast, post-conceptional application of radium or X-ray to the pelvic region in larger doses for therapeutic purposes implies a great risk of damage, especially of the fetal central nervous system. Such treatment should always be preceded by curettage.

Short exposure for roentgenograms during pregnancy most probably is entirely free of any harmful effect on the fetus, granted that this procedure is not too often repeated, especially in early pregnancy.

JACOB H. VASTINE, M.D.

Primary Face Presentation. U. Fernández and F. Tallaferro. *Semana Méd.*, May 14, 1931, XXXVII, 1323-1329.

The authors present this case because the existence of such a condition is so rare that it is doubted by many obstetricians. A woman was examined fourteen days before she went into labor. The obstetrician made the diagnosis of face presentation and called two other physicians on consultation, who made the same diagnosis. To confirm their findings, they took two radiographs several days apart and both of them showed a face presentation. The patient was examined daily for fourteen days until she went into labor, and there was no change of position found at any time. During labor and delivery, the presentation was found to be face.

N. G. GONZALEZ, M.D.

HEART AND VASCULAR SYSTEM (DIAGNOSIS)

Enlarged Hearts. Gastón Giraud. *Semana Méd.*, June 5, 1930, XXXVII, 1456-1463.

In this article, the author treats of enlargement of the heart and goes into detail concerning its diagnosis. In doing so, he discusses the great help obtained from radiology, particularly orthoradiology, which projects on the screen, and teleradiology which prints on a film the heart in its true relations. On de-

scribing the different conditions, he considers their diagnosis from the radiologic point of view.

N. G. GONZALEZ, M.D.

Visualization of Diseases of Peripheral Arteries. V. Kollert. *Wien. klin. Wchnschr.*, 1930, I, 344. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 271.

There are definite indications for arteriography, and the chief of these is a vascular obstructive process. The author discusses the diagnostic and therapeutic values of the method. Of interest are the variations of the capillary bed which are noted after injection of uroselectan.

H. C. OCHSNER, M.D.

Arteriography. M. Sgalitzer. *Wien. klin. Wchnschr.*, 1930, I, 343. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 271.

The author discusses the roentgenologic demonstrable changes in thrombosis, embolism, endarteritis, arteriosclerosis, and spasm. He uses uroselectan in about one-tenth the quantity necessary for intravenous pyelography. There are numerous illustrations, and the author discusses the diagnostic possibilities of the method.

H. C. OCHSNER, M.D.

THE KIDNEY

Hemangioma of the Kidney: A Report of Two Cases and a Brief Résumé of the Literature. David W. MacKenzie and Allan B. Hawthorne. *Jour. Urol.*, August, 1931, XXVI, 205-214.

The authors submit a brief résumé of the literature and report two cases of their own. They find hemangioma of the kidney to be a rare condition. It is usually single, though

cases of multiple hemangioma have been reported. The angiomas may be situated in the pelvis, medulla or cortex, though seldom seen in the latter. The lesion is composed of large cavernous sinuses, lined with endothelium and filled with blood. Injury and ulceration play a part in the onset of hemorrhage, the only constant clinical symptom. The diagnosis is seldom correctly made, and nephrectomy, so far, is the only satisfactory method of treatment.

Jacobs and Rosenberg, and also Jenkins and Drennan, claim that after examination of the pyelograms, in their respective cases, a certain mottled appearance, due to the entrance of pyelographic fluid in the angiomatous spaces, would be sufficient grounds for a diagnosis. The great difficulty in this interpretation would be the deformity caused by the retention of blood-clot in the pelvis. Neoplasm should be kept in mind.

DAVIS H. PARDOLL, M.D.

Two Unusual Cases of Perinephritic Abscess. John A. Taylor. *Am. Jour. Surg.*, July, 1931, XIII, 11-14.

Bilateral perinephritic abscess, although a comparatively rare disease, is probably not as uncommon as one is led to believe by a review of the literature. Hunt, in 1924, reported only one in 106 cases of perinephritic abscess seen at the Mayo Clinic in ten years, and could find only nine cases in the literature at that time. Yet several unpublished cases were mentioned in the discussion which followed the reading of his paper.

This case is presented, not so much as an oddity as an illustration of how persistently the opposite side should be examined for suppurative perinephritis when the clinical course of a post-operative perinephritic abscess case is not satisfactory, because the diagnosis is often very difficult before the X-ray shows signs of a well-developed abscess.

The author reports a case of a metastatic perinephritic abscess which continued to run a temperature following incision and drainage on the right side. The cause of this rise in temperature was found to be a similar condition

on the left side, which was treated accordingly and was followed by recovery.

A second case was that of a perinephritic abscess in a child which, following operative interference, developed a urinary fistula communicating with the pelvis of the kidney. A plastic was done, with complete recovery.

In the discussion by Edwin Beer, the cortical nature of these lesions is stressed, although it is conceivable that some cases start in the perinephritic fat. Also, one should not fail to suspect the opposite kidney in cases of renal infection which continue to run a temperature following operation. The earlier one operates the better the prognosis and the greater the chance of saving the kidney.

In his twenty-odd years of experience, Beer has seen only three cases of bilateral perinephritic abscess. The exciting organism is usually *Staphylococcus aureus*.

As far as X-ray diagnosis is concerned, although not present in all cases, obliteration of the psoas muscle and curvature of the spine to the opposite side have proved of aid as confirmatory physical signs. Frequently the X-ray films reveal this condition even before the physician suspects it. Beer cites such a case which followed a nephrectomy, due to infection from the spine. Aspiration for diagnosis with a needle is a dangerous procedure and should be avoided.

DAVIS H. PARDOLL, M.D.

Spontaneous Rupture of a Kidney, Due to an Encysted Calculus: Report of a Case. Earl Floyd and J. L. Pittman. *Jour. Am. Med. Assn.*, July 11, 1931, XCVII, 98.

This is a report of a case of rupture of the kidney at the site of a stone, present for at least four years, in the lower pole. Slight trauma over a long period of time brought about a tear in the kidney at that point, resulting in a hemorrhage into the perinephric tissue. This was subsequently followed by an infection, with accumulation of pus, which burrowed around the kidney and down along the psoas muscle. Following operation, the kidney became practically normal.

In all cases of spontaneous rupture of the

kidney reported, there was evidence of disease. Many causes are listed as bringing about this condition, such as tuberculosis, acute focal infections, stones, infarcts, polycystic and solitary kidneys.

C. G. SUTHERLAND, M.D.

Some Interesting Cases of Diagnosis of Kidney Diseases. Thomas Canigiani. Röntgenpraxis, July 15, 1931, III, 642-648.

The author reports cases with diagnostic problems involving diseases of the kidneys.

The first case was that of a 62-year-old man with complete retention, hematuria, prostatic hypertrophy, and a diverticulum of the bladder. Cystoscopy showed a decreased excretion of dye from the right ureter. An intravenous pyelogram revealed a poorly functioning right kidney with a filling defect in the lower half. A retrograde pyelography gave the same finding. At operation a carcinoma of the right kidney was found.

The second case was of interest on account of a stone in the pelvis of the left kidney, situated very low in front of the os sacrum. On a flat film the shadow was thought to be a stone in the left ureter. An intravenous pyelogram showed it to be contained in the pelvis of a congenital pelvic kidney.

The third case showed bilateral dystopic kidneys, both being in the pelvis, with a large branched stone on the right. An intravenous pyelogram revealed a hydronephrosis on the right side. A flat film had not been made before, and stones in both kidney pelves were not seen. It is evident that a flat film should always be made before a pyelogram is done.

H. W. HEFKE, M.D.

MEASUREMENT OF RADIATION

X-ray Wave Length Change by Partial Absorption. J. M. Cork. Phys. Rev., June 15, 1931, XXXVII, 1555. (Reprinted by permission.)

The attempt to repeat the experiments of Mr. B. B. Ray in which a change in wave length occurred in an X-ray beam upon

passage through an absorbing substance, has been continued. In the previously reported experiments CuK-radiation was passed through absorbers of boron, beryllium, carbon, nitrogen, and oxygen. These same absorbers have been retried with tungsten L-radiation with a spectrometer of greater dispersion. Although it should have been possible to observe a modified line of $1/3000$ the intensity of the unmodified, in no case has any trace of a modified line been observed.

The Absorption Law of Short Wave Gamma Rays. Lise Meitner and H. H. Hupfeld. Ztschr. f. Physik, 1931, LXVII, 147-168.

By means of a Geiger-Müller tube counter, the authors made a series of absorption measurements of various substances by a well-defined bundle of gamma rays. This bundle was obtained by placing the radium preparation in a large block of iron ($69 \times 50 \times 42$ cm.) which had a fine opening on one side. Four millimeters of lead were used as a ground filter, and it was possible with this arrangement to isolate a homogeneous wave length 4.7 X-E. from thorium C" and an average wave length of 6.7 X-E. from radium C. The weakening effect in using these short wave lengths is due only to scattering, and the measurements, therefore, make it possible to determine the coefficient of scattering. In comparing the values thus obtained with those gained with Klein and Nishina's theoretical formula, it was found that the results agreed only for elements of a low atomic number. For elements with a high atomic number, the scattering was found to be larger than indicated by the formula.

OTTO GLASSER, Ph.D.

MIKULICZ' DISEASE (THERAPY)

Use of Roentgen Therapy in Mikulicz' Disease. István Farkas. Magy. Röntgen Közl., IV, 143-147, and Deutsch. Zusammenfassung, 1930, pp. 150, 151. Abstracted in Zentralbl. f. d. ges. Radiol., Dec. 12, 1930, IX, 616.

Fittig was the first (1904) to use roentgeno-

therapy in Mikulicz' disease. The author reports six cases, in one of which therapy was of no avail, in four a cure was accomplished, and in one a recurrence took place after four years. The salivary and lacrimal glands were irradiated at six-week intervals, giving 390 r. with heavy filtration, at each treatment. Roentgenotherapy is the method of choice in the treatment of this disease.

H. C. OCHSNER, M.D.

RADIATION THERAPY

Roentgen Therapy of Agranulocytosis. U. Friedemann and A. Elkeles. *Deutsch. med. Wchnschr.*, 1930, I, 947-950. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 616.

The authors irradiated the long bones, using 1/20 H.E.D. of highly filtered rays. Of forty-three cases of agranulocytosis, eighteen were complicated by sepsis and five by pneumonia. These all died despite treatment. Of fifteen uncomplicated cases thirteen were cured. The effect of irradiation was noted within twenty-four hours, in the favorable cases.

H. C. OCHSNER, M.D.

Factors Concerned in Radiation Therapy of Malignant Disease. L. R. Sante. *Illinois Med. Jour.*, July, 1931, LX, 82-84.

The factors discussed by the author are as follows: (1) The location and size of the growth; (2) the degree of radiosensitiveness of the tumor cells, and (3) the environment of the tumor cells as to whether or not the growth is dependent upon the blood supply for its nutrition or whether it gets a supply also from the lymph, as in metastatic growths in lymph nodes.

The author mentions three types of reaction of tumor cells to radiation: Autolytic, necrotic, and growth-restraining. He concludes as follows:

"Never consider any malignant growth, no matter how small it may be or how slight the

involvement may seem, to be insignificant, and conversely, never consider any malignant growth, no matter how large or extensive it may seem, to be hopeless until it has been given the 'test of irradiation.'"

CHARLES H. DEWITT, M.D.

Hypertrichosis Following Parotitis; Roentgen Therapy. E. Lesné, Germaine Dreyfus-Sée, and J.-A. Lièvre. *Bull. Soc. Pédiatr. Paris*, 1930, XXVIII, 94-110. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 617.

A seven-year-old girl developed an endocrine symptom complex over a period of three years, following a bilateral parotitis. There was cessation of growth, adiposity, marked hypertrichosis, and onset of menstruation at nine. Following irradiation of the adrenal region, the hypertrichosis promptly disappeared.

H. C. OCHSNER, M.D.

Roentgen Treatment of Root Pains. J. Laborderie. *Rev. d'Actinol.*, May-June, 1930, VI, 221-236. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 617.

Roentgen therapy gives relief in a large percentage of cases after all other methods have failed. The mechanism is an attack on the inflammatory infiltration about the nerve, analogous to the surgical liberation of the nerve caught in scar tissue.

H. C. OCHSNER, M.D.

Radiotherapy in Infantile Poliomyelitis. Louis Delherm and Pierre Mathieu. *Rev. d'Actinol.*, 1929, V, 683-690. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 280.

The roentgen therapy of poliomyelitis as suggested by Bordier should be used early and systematically. The results are satisfactory, although they do not differ particularly from

those obtained by other methods. The method offers no certainty of cure except in the earliest stages of the disease, and one should, therefore, be extremely careful in offering a prognosis.

H. C. OCHSNER, M.D.

The Histologic Evaluation of the Effect of Radiation on Carcinoma. J. Wätjen. Deutsche med. Wchnschr., April 17, 1931, LVII, 662-664.

The author states that it is very difficult to solve a complicated problem, as the radiobiology of tumors, by histologic investigations alone. If we summarize our present knowledge concerning the histologic changes following the irradiation of neoplasms, we must conclude that the inhibitory effect on the carcinoma cells is most important. The reaction in the surrounding tissue must not be disturbed by too high a dose; severe systemic reactions should also be avoided, since the resistance of the organism, as a whole, has a far-reaching influence on the results of radiation therapy.

ERNST A. POHLE, M.D., Ph.D.

RADIUM

Radium Therapy. Editorial. British Med. Jour., Oct. 18, 1930, No. 3641, p. 651.

This is a report of some of the conclusions reached by the National Radium Trust and the Radium Commission, after their first year's stewardship, and amounts to a guarded and provisional verdict of "Not Proven."

The commissioners insist upon the need for great caution in estimating the value and efficiency of radium in the treatment of cancer, and deprecate in the strongest terms the kindling of false hopes by means of sensational or even optimistic statements.

They conclude that the best that can be said is that some results under certain conditions are very satisfactory; that others, for no clearly established reasons, are less so. The results are either inconclusive or definitely dis-

appointing in a considerable proportion of the cases. This, in their opinion, does not justify a pessimistic outlook, because many problems that yet remain unsolved may yield to experience and research.

In regard to malignant disease generally, the Commission states, as its considered opinion, that while radium "holds out a good promise of beneficial results, and certainly of alleviation of suffering, it is at present a very dangerous weapon, and one which, unless used with the greatest skill, care, and precaution, may easily be productive of more harm than good."

W. D. MACKENZIE, M.D.

The Methods for Testing Radium Preparations Used by the Physical Laboratory of the Radiumhemmet, Stockholm. Rolf M. Sievert. Acta Radiol., 1930, XI, 649-657.

Various methods of testing radium preparations in the Radiumhemmet, Stockholm, are described and illustrated in a number of diagrams. The strength of the preparation is determined by means of a two-electroscope arrangement, which avoids the errors inherent in measuring with only one instrument. The electroscopes are built of zinc. Possible leakage of the radium preparation is detected by bringing the preparation into an evacuated vessel in which air is afterward brought, which, in turn, is then examined for traces of radium emanation. The distribution of the salt within a capsule is examined by a photometric method. All the data of these tests are collected on a calibration card which accompanies each preparation.

OTTO GLASSER, Ph.D.

The Physics and Biophysics of X-rays and Radium. W. H. McGuffin. Canadian Med. Assn. Jour., May, 1931, XXIV, 679-684.

This is the fourth paper in the series being contributed by the members of the Canadian Radiological Society for the education of the general profession along radiological lines.

The author discusses, in a clear and concise manner, such subjects as the X-ray tube, the physical properties of the X-ray, the discovery, sources, and measurement of radium, the nature of radio-activity, the preparation of radon, the types of radium rays, the transmission of rays through the tissues, the filtration of radium, and the biophysics of X-rays and radium.

The author demonstrates that therapy applied by the use of X-rays and radium has a strictly scientific basis. He closes with this outlook: "The future of radiotherapy in the field of medicine rests entirely upon the basis of a greater knowledge of the physical properties of radio-activity and a correlation of these with the biological effects."

L. J. CARTER, M.D.

Medical Uses of Radium. Special Report, Medical Research Council, No. 150, Bull. Hyg., 1930, VI, 380.

An account is given of the research on Ra therapy in 1929. The current technic used in the various laboratories is described, as well as the effect on the various types of cells. The time of exposure if regulated may produce beneficial results, while unregulated exposure may aid the disease by the destruction of the cells, as is found in the variation in the action of many drugs when the dose is varied.

CHEMICAL ABSTRACTS.

THE SINUSES (THERAPY)

Treatment of Hay Fever by Intranasal Zinc Ionization. Philip Franklin. British Med. Jour., June 27, 1931, No. 3677, p. 1115.

The problem of hay fever has of recent years been studied from many angles. Specific and non-specific desensitization has yielded only moderate results. The following technic is placed on record because of the uniformly successful cures obtained by intranasal zinc ionization.

The intranasal mucosa is covered with thin layers of cotton-wool, soaked in a 1 per cent

solution of zinc sulphate in distilled water. Particular care should be taken to cover the middle turbinate and the adjacent septal mucous membrane. A zinc terminal is placed in each nostril and connected with the positive pole of a galvanic battery. The indifferent electrode is applied to the forearm or hand. A current of from three to five milliamperes is passed for from fifteen to twenty minutes.

If the tissues are swollen and irritable, they should be sprayed with a 4 per cent solution of cocaine before applying the wool. The patient experiences a metallic taste and increased salivation, a conjunctival hyperemia, with lacrimation or blushing during the ionizing process, and may have attacks of sneezing during the subsequent twenty-four hours.

One or two treatments at an interval of seven days are required to cure the hay fever for that season. It is generally necessary to repeat the treatment each season.

W. D. MACKENZIE, M.D.

THE SKULL (DIAGNOSIS)

A Probe in the Cranial Cavity for Seventeen Years. J. S. McEachern. Canadian Med. Assn. Jour., May, 1931, XXIV, 692, 693.

On November 17, 1925, a single man, aged 33, presented himself complaining of attacks of "fits."

In October, 1908, he had been shot in the head with a shotgun. There was a great deal of damage to the frontal bone. The right eye was destroyed and had to be enucleated. As a result of the injury, he was ill for 132 days. In February, 1910, he had a "fit." Just before it came on he found that his head rotated to the right. He was unconscious after the "fit" for half an hour. For the next eleven years he had a similar seizure every four or five months. For the four following years he had an attack every three or four weeks.

A radiograph, the reduction of which accompanies the case report, shows the shadow of a probe in the cranial cavity. The eye of the probe lies opposite the scar tissue, filling

the bony defect at the lower part of the forehead. The probe passes from this point upward and to the left. The probe was removed through an incision in the scar tissue. The recovery was uneventful. Freedom from "fits" has followed for five years, up until the time of this report.

L. J. CARTER, M.D.

THE SPINE (DIAGNOSIS)

Case Reports of Spondylitis Ankylopoietica. I. Odessky. *Röntgenpraxis*, June 15, 1931, III, 544-550.

Ossification of the connective tissue of the joint ligaments with an ankylosis of the small joints of the spine is the pathologic basis for a spondylitis ankylopoietica (also called Bechterew-Strümpell-P. Marie disease). The vertebral bodies usually show more or less atrophy and decalcification. Hereditary factors, infections, and trauma have been considered as etiologic factors. One case is described in which not only the vertebrae, but also many other joints were attacked, the patient being rigid and rendered entirely an invalid. Such a picture may be called polyarthritis chronica ankylopoietica. Three other cases are described, in which the spine was mainly attacked, but which had only a few symptoms. No therapeutic efforts seem to be of any value.

H. W. HEFKE, M.D.

Spinal-cord Tumor: Two Case Reports. Fred E. Woods and Wendell S. Keate. *Med. Herald, Phys. Ther., and Endocrine Survey*, July, 1931, L, 278-281.

The authors report two cases of spinal cord tumor. The first patient's original complaint was pain in the left chest. Nine months later he developed spastic paralysis in the lower extremities. Physical examination at this time showed multiple fibroma of the skin. The impression derived from X-ray examination of the chest at this time was neoplasm in the left upper lung, probably benign. X-ray films of

the spine and pelvis showed no apparent pathology. Autopsy five months later revealed a post-pleural tumor, diagnosed a neurofibroma, arising from between the first and second thoracic vertebrae, with compression of the cord.

The second patient on admission complained of numbness in the feet and legs, difficulty in walking, and pain in the lower back. An X-ray examination of the spine and pelvis showed no bony changes. Other clinical signs pointed to a spinal cord tumor. The patient died eleven months later, an endothelioma being found at that time. The mass extended through the spinal canal from the level of the seventh dorsal vertebra to the cauda equina.

The authors cite these cases to show the difficulty of diagnosing spinal cord neoplasms.

W. S. PECK, M.D.

A Contribution about Spina Bifida in the Region of the Dorsal Vertebrae, and the Trophoneurosis Connected with It. V. L. Towbin and R. I. Jalin. *Röntgenpraxis*, July 1, 1931, III, 622-624.

Spina bifida in the region of the lower lumbar and sacral spine is not infrequently seen; its occurrence in the dorsal spine, however, is rare. A man, 52 years old, presented a scar-like depression over the fourth dorsal vertebra, over which there was an increase of hair growth. He complained of some pain in that region and in the upper extremities. Roentgenologic examination showed an irregular defect in the arch of the third and fourth thoracic vertebrae corresponding to the picture of spina bifida. The spinous process of the second thoracic vertebra was absent.

H. W. HEFKE, M.D.

THE SPINE (THERAPY)

Bordier's Method in Poliomyelitis. G. Ronneaux. *La Presse Méd.*, March 25, 1931, XXXIX, 439.

This is an account of 15 cases treated by a combination of radiotherapy, diathermy, and galvanism (Bordier's method), with excellent

results. The author believes that the results of this combined method of treatment are better than those obtained by radiotherapy alone. Great importance is attached to the technic of application of the X-rays, which, however, is not detailed in the present account of the communication to the French Society of Electrotherapy and Radiology.

WALTER M. LEVITT, M.B., M.R.C.P., D.M.R.E.

General Considerations on Forty Cases of Scoliosis. Sara Satanowsky. *Semana Méd.*, Jan. 29, 1931, XXXVIII, 305-326.

The author gives herein a very extensive and complete treatise on the different types of scoliosis and their treatment. She presents forty cases which she has treated and shows X-ray film reproductions of the different conditions. The article is of great value to orthopedists.

N. G. GONZALEZ, M.D.

SYPHILIS

The Various Aspects Presented by Syphilis in Dermatologic Practice. José Luis Carrera. *Prensa Med. Argentina*, June 20, 1931, XVIII, 96-100.

The author bases this article on 949 cases of syphilis which he has treated in the last four years. He considers every type of syphilis, except the primary and congenital forms, giving histories of several cases. He presents a radiograph of a gastric ulcer cured with antisyphilitic treatment, which is the only case of this kind that has come under his observation.

N. G. GONZALEZ, M.D.

Studies on Congenital Syphilitic Bone Disturbances Found in Early Childhood. M. Péhu and A. Policard. *Rev. franç. Pédiatr.*, 1929, V, 655-667. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 269.

The designation, syphilitic osteochondritis, is inaccurate inasmuch as the pathologic changes are in bone rather than in cartilage.

The site of changes is the end of the diaphysis just proximal to the epiphyseal margin. As in other syphilitic processes, the chief change is in the vascular system; there is hypervascularization and vasodilation, with resultant atrophy of bone substance. The growth processes are not interfered with, but there is a rarefaction of the bone, with consequent liability to fracture.

H. C. OCHSNER, M.D.

THE THYMUS (DIAGNOSIS)

A Malignant Tumor of the Thymus Gland. W. Cecil Bosanquet and W. Ernest Lloyd. *The Lancet*, July 4, 1931, CCXXI, 6-9.

The authors present the case history of a girl twenty years of age who died in an attack of dyspnea. The patient had been studied, and although a tentative diagnosis of pulmonary tuberculosis had been made, radiographic evidence was not characteristic. At autopsy the thymus was found to be the site of a tumor, and pulmonary metastases were present in the lower part of both lungs, without involvement of the tracheal glands. Histologic study suggested an endothelioma and not a tumor of thymic origin.

The authors review the literature and suggest that many carcinomas of the thymus may have been endothelial in origin because of the similarity in appearance to carcinoma.

The paper is concluded by discussions of symptomatology, diagnosis, treatment, and prognosis of tumors of the thymus gland.

H. J. ULLMANN, M.D.

Roentgen Studies of the Thymus Gland in Children: Diagnosis and Treatment. J. W. Frank. *Jour. Am. Inst. Homeop.*, June, 1931, XXIV, 553-558.

The author discusses the importance of a careful and uniform technic in making roentgenograms of the thymic gland in children. He has followed Wasson's method of making the X-ray exposure in the postero-anterior po-

sition, at full inspiration, with the child in the recumbent position. In the lateral projection the patient is placed on the left side, with the arms back of the body and the chest thrown forward, so as to bring the anterior mediastinum well forward.

On roentgenograms the enlarged thymic gland will appear as an enlargement of the shadow from the base of the heart upward, with this shadow slightly overlapping the base of the heart, and extending symmetrically to either side of the spine, the upper limits being just below the clavicles. When the lateral enlargements are from one and a half to twice the width of the bodies of the third and fourth dorsal vertebræ, the thymus gland may be safely considered enlarged. The lateral borders of an enlarged thymus are smooth and sharply defined. In the differential diagnosis a submerged thyroid has its base above, narrowing below and merging with the thickening in the neck. In tuberculous mediastinal glandular enlargements, the shadow is denser, the edges are convex, and it is widest near the root of the lungs. The lateral enlargement is of less importance than thickening in the antero-posterior dimension, for it is this latter type of enlargement which is more apt to cause pressure on the mediastinal structures. Therefore, the lateral view not only gives the exact thickness of the gland but also the relation of the gland to the trachea, and information regarding compression or distortion of the trachea.

While some cases show evidence of an enlarged thymus on roentgenograms, and demonstrate no symptoms clinically, the author believes that under normal conditions there may be no pressure on the respiratory structures. However, what may happen in case of respiratory diseases must be considered, for the gland is known to enlarge during respiratory effort. This group of symptomless thymic enlargement cases comprises, undoubtedly, those which have not undergone accidental involution from disease, those in which the rate of chest growth has not kept pace with the thymus, as well as those with glands considered potentially a menace. An infant presenting an enlarged thymus with symptoms should have

radiation treatment, whereas an infant presenting an enlarged thymus without symptoms need not have irradiation unless an operative procedure with general anesthesia is contemplated.

The author's technic for the treatment of an enlarged thymic gland is as follows: 85 K.V., 4 ma.; filter of 4 mm. aluminum; focal skin distance of 10 inches; 1 to 2 minutes; two ports of entry. This treatment is repeated in from four to seven days. Two treatments are given and then roentgenograms of the chest are made to determine the amount of reduction of the gland. These findings, with the clinical symptoms, determine whether another application is necessary.

J. N. ANÉ, M.D.

The Thymus Gland in Infancy. C. S. Raue and C. C. Fischer. *Jour. Am. Inst. Homeop.*, June, 1931, XXIV, 545-552.

The authors review the history of the thymus gland in medical literature and discuss the symptomatology, diagnosis, and treatment of enlargement of this organ.

Sudden death in connection with the presence of an enlarged thymus was noted as early as the eighteenth century. About a hundred years ago, Kopp noted the relationship of the thymus gland to laryngospasm, and coined the phrase "thymic asthma" to designate this condition. In 1889, in his monograph, Paltaur expressed the opinion that thymic enlargement was a manifestation of a constitutional disorder in which thymus hypertrophy, general lymphatic hyperplasia, enlargement of the spleen, hypertrophy of the tonsils, and hypoplasia of the circulatory system were usually associated. This syndrome is known as "status lymphaticus." Pathologists, however, do not accept the theory that there is any connection between thymus hyperplasia and the so-called status lymphaticus.

The thymus attains its maximum development at the time of puberty. After this time it gradually undergoes a process of involution. It is situated in the superior portion of the anterior mediastinum, and normally extends

downward as far as the fourth costal cartilage. The normal weight of the gland varies with the age and weight of the child.

The symptoms usually attributed to enlargement of the thymus gland in infants are cough, dyspnea, cyanosis, and stridor. These result from pressure of the gland on the surrounding structures, such as the trachea and recurrent laryngeal nerve. Examination of these infants reveals substernal dullness and a palpable mass in the suprasternal notch. The value of the X-ray diagnosis of enlarged thymus has been discussed by many writers. The authors believe that correlation of the clinical findings with the X-ray evidence is necessary for a definite diagnosis.

In 100 consecutive new-born infants in the obstetrical wards of the Hahnemann Hospital, in Philadelphia, the thymic shadows were studied within forty-eight hours of birth. If the thymic shadow was found to be enlarged, a second roentgenogram was made on the tenth day after birth. The normal thymic shadow was considered one in which the mediastinal shadow at the level of the second thoracic vertebra was from one and one-third to twice the transverse diameter of this vertebra. Of the 100 new-born infants 62 were found to have enlarged thymic shadows. Sex, primiparity, or multiparity of the mother seemed unimportant factors, but race and birth weight showed a definite relationship to the number of positive roentgenograms, the negro infants and those whose birth weight was in excess of eight pounds showing the highest percentages. Roentgenograms of the 62 positive cases, taken ten days after birth, showed that one-third had an increase in the thymic shadow, one-third a decrease, and the remaining third no marked change. Twenty-four cases showing increased or stationary thymic shadows were again examined roentgenologically at the age of six weeks. Of this number about one-third showed increase, one-third showed decrease, and one-third showed no change. At six months, of six infants showing increase in the thymic shadow, 50 per cent showed decrease, 33 per cent a continued increase, and 17 per cent no change. None of these infants at any time showed di-

rect symptoms indicating the presence of an enlarged thymic gland, nor did any of these cases receive X-ray or radium therapy to reduce the size of the gland.

J. N. ANÉ, M.D.

THE TONSILS

Roentgen Therapy of Tonsils. G. Schulte. *Fortschr. Röntgenstr.*, 1930, XLII, 120-122. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Dec. 12, 1930, IX, 610.

The author treated 257 cases, 132 of which were children varying in age from two to fourteen, and 125 adults. One hundred sixty-nine of the 257 had good results, 12 were improved, 8 unimproved, and 40 unknown. Twenty-eight were still under treatment. Exclusive of the last two groups 90 per cent were cured, 6 per cent improved, and 4 per cent unimproved. The cases were all of the bilateral chronic inflammatory type. The tonsillar region on each side was treated, the tube angling upward.

One-third H.E.D. was given in children, using an F.S.D. 30 cm., 140 K.V., 4 mm. Al, fields 6×8 cm., and $\frac{1}{3}$ H.E.D., with 210 K.V., 1 mm. Cu, plus 1 mm. Al in adults. The same treatment was repeated in four weeks and if necessary again in eight weeks. Most of the patients had suffered from repeated sore throat, 90 per cent being free of this complaint after treatment.

H. C. OCHSNER, M.D.

TUBERCULOSIS (DIAGNOSIS)

Is Bronchoscopy Indicated in Tuberculosis? Louis H. Clerf. *Jour. Am. Med. Assn.*, July 11, 1931, XCVII, 87-90.

With the general acceptance of bronchoscopy as an invaluable aid in the diagnosis of obscure pulmonary lesions and in the treatment of abscess in the lung, and bronchiectasis, the question is often asked, "Is bronchoscopy indicated in tuberculosis?"

In the treatment of uncomplicated pulmonary tuberculosis, bronchoscopy is not indi-

cated. Its value in tuberculosis is limited largely to diagnosis, although certain cases may be benefited by treatment. Symptoms unexplained by routine methods were, in individual cases quoted, cleared up by bronchoscopy.

Unsuspected pulmonary tuberculosis in pulmonary abscess, suspected bronchial foreign body, and asthma were discovered. Tuberculosis of the tracheal or bronchial walls is exceedingly rare, one case being reported as found by bronchoscopy. Hemoptysis is not uncommon in cancer of the bronchus and in bronchiectasis. The occurrence of hemoptysis contributes more often to an erroneous diagnosis of tuberculosis than any other sign or symptom. Obscure hemoptysis should be an indication for bronchoscopy.

C. G. SUTHERLAND, M.D.

A Case of Chronic Military Pulmonary Tuberculosis. M.-E. Meyers-Palgen. *Jour. Belge Radiol.*, 1930, XIX, 41, 42. Abstracted in *Zentralbl. f. d. ges. Radiol.*, Sept. 19, 1930, IX, 273.

The author examined a 50-year-old man in whom pneumoconiosis could be definitely excluded. In the radiograph there were countless military shadows extending over both lung fields. There was no clinical evidence of activity. The author concludes that, as a result of an exceptional resistance of the patient's organism, the entrance of tubercle bacilli into the circulatory channels was prevented.

H. C. OCHSNER, M.D.

Hilar Dance, Silent Deviation of the Trachea, and Inhibition of the Right Phrenic Nerve in a Case of Pulmonary Tuberculosis. Alejandro A. Raimondi, Ramón Pardal, and Egidio S. Mazzei. *Prensa Med. Argentina*, June 10, 1931, XVIII, 4-11.

The authors present this case of pulmonary tuberculosis because of the lesson it teaches. A man, 38 years old, without any symptoms whatsoever, had a sudden hemoptysis. Physi-

cal and sputum examinations showed tuberculosis. The radiograph was interesting in that it revealed the following: (1) A retractile tuberculous sclerosis of the superior lobe of the right lung, with silent deviation of the trachea; (2) inhibition of the right phrenic nerve, as shown by paralysis of the right diaphragm, and (3) hilar dance—also known as hilar pulsation. These three findings were seen on many radiographs.

The hilar dance was studied by taking very rapid films and comparing them over millimeter paper. The authors attribute the hilar dance to an arterial pulsation at the hilum. Pezzi and Silingardi were the first to describe this phenomenon and attributed it to insufficiency of the pulmonary valve, while Miranda Gallino and the authors attributed it to sclerosis of the vessels associated with pulmonary hypertension. This phenomenon is of importance, because many of the hilar shadows frequently attributed erroneously to adenopathy are essentially vascular shadows.

N. G. GONZALEZ, M.D.

TUBERCULOSIS (THERAPY)

The Carbion Treatment in Pulmonary Tuberculosis. Rodolfo A. Vaccarezza and Francisco Martinez. *Semana Méd.*, Dec. 18, 1930, XXXVII, 1853-1877.

Carbion is a suspension of very fine particles of charcoal contained in a solution of calcium chloride. From 0.2 to 1 c.c. is injected intravenously, and the patient is put to bed until the reaction subsides. This is repeated every ten days, the dose varying according to the tolerance of the patient, and is continued for from six to eight months. X-ray films are taken all along.

Ten cases treated by the authors gave the following clinical and radiological results: seven grew worse; three had hemoptysis and other complications during the treatment; one showed no change, and two improved. The authors conclude that any similar substance either does not affect the patient or is injurious to him.

N. G. GONZALEZ, M.D.

TUMORS (DIAGNOSIS)

Tumors of the Duodenal Bulb and Their Roentgenologic Diagnosis. I. G. Brdiczka. *Röntgenpraxis*, July 15, 1931, III, 625-629.

Carcinomas of the duodenum are rare. They are supposed to originate from heterotopic gastric mucosa or from the epithelium of the duodenal papilla. Myomas, fibromyomas, and fibrosarcomas have been found in the duodenal bulb; the occurrence of lipomas, tuberculomas, and hemangiomas has also been described. Three cases with tumors of the duodenal bulb are presented.

The first case had a large filling defect in the pyloric region and was diagnosed roentgenologically as a pyloric carcinoma. Exploration showed a large, fixed, inoperable tumor in the antrum of the stomach. At autopsy, a large ulcerating carcinoma was found in the duodenal cap, which infiltrated the entire wall of it. The incorrect roentgenologic diagnosis is explainable by compression of the antrum by the large tumor originating in the duodenum just above the pylorus.

The second case showed a large filling defect in the greater curvature side of the duodenal cap, which apparently corresponded to a palpable tumor. The mass was fixed to the duodenal bulb. At operation, a well circumscribed tumor was removed, which originated from the wall of the duodenal cap. Microscopic examination showed it to be a fibromyoma. Roentgenologically, a diagnosis between a tumor originating in the duodenum and one only fixed to the duodenum could not be made.

The third case showed several round filling defects, the size of a hazelnut, in the duodenal cap. These defects were very plain when external pressure was applied. A polyposis or multiple myomas were mainly considered, but a polypoid carcinoma could not be excluded.

It is in most cases possible to decide if a tumor leading to a deformity of the duodenal bulb is extrinsic or intrinsic. A definite differential diagnosis between benign and malignant tumors cannot be made roentgenologically.

H. W. HEFKE, M.D.

Neuroma of the Mediastinum. Juan José Beretervide, Juan Mariano Fazio, and Juan B. Cardenau. *Prensa Med. Argentina*, June 10, 1931, XVIII, 41-46.

Herein the authors present an interesting case of a large neuroma of the posterior mediastinum in a man 39 years old. In 1923, when first seen, his symptoms were chronic cough, with expectoration of blood-tinged sputum, and, under the right breast, a severe pain which would be present for a few days and then disappear for months, only to recur again. He continued this way until 1928, when he had a very severe attack of pain. Physical examination revealed a mass in the right lung, a radiograph confirming the findings. A diagnosis of hydatid cyst was made and an operation performed. On finding a solid mass, nothing was removed.

Two years later, a second radiograph was made, and the mass was larger than it had previously been, and presented a typical picture of neuroma of the mediastinum as described by Leuk—oval in shape, homogeneous, unilateral, the mass implanted over the posterior mediastinum. With these findings and by exclusion, the authors decided on the diagnosis of ganglioneuroma of the posterior mediastinum.

N. G. GONZALEZ, M.D.

TUMORS (THERAPY)

Adenoma of the Bronchus. R. Kramer. *Ann. Otol., Rhinol. and Laryngol.*, September, 1930, XXXIX, 689-695. (Reprinted by permission from *Cancer Review*, 1931, VI, 323.)

The author found only five cases in the available literature, and adds two of his own. Bronchial adenoma arises in the ducts of the mucous glands, which should be removed endoscopically, or treated by radium implantation or diathermocoagulation or a combination of these methods.

F. CAVERS, D.Sc., M.R.C.S.

Chondrosarcoma of the Tibia of a Guinea Pig, Following Roentgen Irradiation. M. Lüdin. *Schweiz. med. Wchnschr.*, 1930. I

162. Abstracted in Zentralbl. f. d. ges. Radiol., Sept. 19, 1930, IX, 249.

After daily irradiation over a period of months, there developed in the tibia of a guinea pig a thickening of the cortex, with an accompanying joint contracture. The radiograph demonstrated a high grade destructive process involving the bone tissue. Microscopic section showed the picture of chondrosarcoma.

H. C. OCHSNER, M.D.

The Roentgen Treatment of Mediastinal Tumors. A. U. Desjardins. Röntgenpraxis, July 15, 1931, III, 657-665.

The mediastinal tumors offer many difficulties in diagnosis and therapy. A roentgen examination can demonstrate the extent but not the microscopic character of such lesions. A biopsy is of great help when the tumor has metastasized into palpable lymph nodes. Irradiation therapy can furnish very valuable assistance in the differential diagnosis of mediastinal tumors. If they consist mostly of lymphatic cells, they will regress rapidly. Mediastinal tumors of other nature (carcinomas, sarcomas, except lymphosarcomas) are much more resistant to rays. This different behavior differentiates the first group (lymphoblastomas) very easily. Only inflammatory processes might react similarly.

The prognosis in the group of mediastinal tumors, which includes Hodgkin's disease, lymphatic leukemia, and lymphosarcoma, is still hopeless in practically all cases. The average duration of life without systematic treatment is about two and one-half years. An intelligent course of treatment usually leads to considerable improvement over some months, or even years. Dyspnea, cough, congestion, dilatation of the superficial veins, and hydrothorax often disappear after roentgen irradiation, and the general condition of the patient improves correspondingly, the rapidity of improvement being characteristic of these tumors. The results of the treatment depend on the extent, the duration, and the localization of the disease. Some advanced cases can be benefited considerably. If the disease is dis-

covered in an early stage, the chances of controlling it for a longer time are considerably better.

The case of a 27-year-old woman is described, being diagnosed as Hodgkin's disease, in 1921 (biopsy). She had X-ray treatments at that time. In 1927, a recurrence took place, which, however, reacted favorably again to irradiation. At present, the patient is symptomless.

Irradiation therapy in epithelial new-growths in the mediastinum shows much slower and not so lasting results.

H. W. HEFKE, M.D.

Calcification of a Suprasellar Tumor Causing Fröhlich's Syndrome which had been Irradiated Eighteen Years Previously. Angelo Santoro. Archivio di Radiologia, March and April, 1931, VII, 185-192.

The author reports a case of Fröhlich's syndrome in a patient with a suprasellar tumor. X-ray treatment over a period of eighteen years resulted in calcification of the tumor and marked remission of symptoms. The author emphasizes the value of roentgenotherapy in this disease.

E. T. LEDDY, M.D.

The Weight Curve as a Prognostic Sign in the Treatment of Malignant Tumors. Adolf Zuppinger. Röntgenpraxis, July 15, 1931, III, 665-669.

Examination and the critical evaluation of the subjective symptoms of the patient give a fair picture of the condition of a patient with a malignant tumor. The weight curve is of great value as a fairly dependable objective criterion. During the time of the protracted fractionated irradiation, the weight decreases generally, depending on the initial general condition and the severity of the reaction. Especially in cases in which the pharynx is in the course of the rays, the loss of weight is often very marked (radio-epithelitis), from 5 to 10 kilograms not being unusual. In favorable cases the weight increases rapidly after the reaction has subsided until it reaches the

initial point and rises from there gradually to about the normal level of the patient. If the tumor has not been destroyed completely, the weight level at admission is usually not reached again; renewed activity is plainly seen on the curve by a decrease. If distant metastases are present, the weight increases for a while, but afterwards gradually drops.

Several histories with corresponding weight curves are given to illustrate the value of observing and charting the weight. The curve represents, especially in patients with malignant tumors, fairly accurately and easily the general condition of the patient and is of great help for the prognosis. Of course, one must remember that heavy work, intercurrent diseases, psychic influences, etc., may change the weight curve independent of the course of the malignant disease.

H. W. HEFKE, M.D.

ULCERS (ETIOLOGY)

The Etiology of Gastric and Duodenal Ulcers: A Large Section Histologic Study of Local Blood Vessel Changes in Post-mortem Specimens (Preliminary Report). C. Bryant Schutz. *Jour. Am. Med. Assn.*, June 27, 1931, **XCVI**, 2182-2185.

The experimental evidence in most theories concerning the etiology of gastric and duodenal ulcers agrees in one fundamental respect: *e.g.*, the direct cause of ulcer is arterial obstruction.

From the histologic standpoint this theory of arterial obstruction has met considerable objection. A study was made of thirty fresh autopsy specimens of ulcer. In every one of the thirty specimens arterial obstructive lesions were found in the ulcer region. Obstruction of an artery was not found in any of the more normal portions of the stomach and duodenum.

The author's conclusions were as follows: (1) Ulcers of the stomach and duodenum are the direct result of infarction, due to any disease or mechanism which causes arterial occlusion. (2) Once the ulcer is formed, its subsequent course is determined by secondary

arterial changes. (3) The ulcer progresses largely as a result of the formation of small infarcts produced by secondary closure of capillaries in the floor of the ulcer. (4) In the majority of patients with ulcer, lesions capable of producing emboli, evidence of obliterating arterial disease, or infarction are found in other organs of the body.

C. G. SUTHERLAND, M.D.

The Local Radiologic Signs of the Stages of Development of Duodenal Ulcer. Giuseppe Martinotti. *Minerva Medica*, 1931.

The duodenal bulb is that segment of the digestive tract between the pyloric ring and the descending portion of the duodenum. It presents a base, an apex (fixed in most of the cases), and four walls. The two lateral walls are improperly called the margins or curvatures. The bulb is the preferred location for the ulcer, which is, as a rule, single; multiple duodenal ulcers are very rare.

The purpose of this work is to describe the roentgenologic deformities of the duodenal bulb induced by ulcer, the X-ray symptomatology of duodenal ulcer varying according to its location and stage of development.

Location of the Duodenal Ulcer.—The author thinks that the designation of duodenal ulcer as an ulcer of the walls or of the curvature is insufficient; he proposes the following classification:

(1) Ulcer of the base: juxtapyloric, close to the pylorus.

(2) Ulcer of the base: parapyloric, at the periphery of the base.

(3) Ulcer of the middle portion of the walls: located in the middle or central portion of the anterior and posterior wall.

(4) Ulcer of the lateral portion of the walls: located in the middle and lateral portion of the anterior and posterior wall or in the middle portion of the margins.

(5) Ulcer of the distal portion of the walls.

There are three stages in the development of duodenal ulcer as observed roentgenographically: (1) The initial ulcer; (2) the ulcer with extensive areas of sclerosis and scarring, and (3) end-results of the sclerosis.

First Stage.—The X-ray sign is the *niche*. This has the shape of a nail-head or a star, if the ulcer is on an anterior or posterior wall, and a niche in profile, if it is on the lateral wall. The nail-head niche may show better when the bulb is empty. Sometimes the ulcer of the walls shows like a clear area in the shadow of the bulb, as if the niche contained air instead of barium. The niche of the lateral walls is very rare compared to those of the anterior and posterior walls.

The author does not think the swallow-tail niche of Akerlund reliable as a direct sign of ulcer, as it can be imitated by a localized hypotonus of a segment of the wall when the surrounding parts are sclerosed by secondary chronic infiltrating processes, due to periduodenitis. In this first stage the bulb is, as a rule, ectatic.

Second Stage.—The sclerosis of the wall, which has already begun in the first stage, becomes more severe and gives origin to characteristic deformities of the bulb.

The sclerotic retraction of the walls and the healing of the ulcer do not always go hand in hand. The second is difficult to follow, since it is not easy to say when the niche is definitely closed and the ulcer covered with epithelium. The sclerotic retraction of the walls can be seen by the X-ray after a certain period.

The consequences of the sclerosis are: Rigidity of the wall which carries the ulcer; disappearance of the angle between the wall and the base; gradual retraction of the most mobile and closest portion of the remaining walls towards the ulcerated area.

The X-ray Signs.—(1) Eccentricity of the bulb in relation to the pylorus—this sign has no value if it is alone, as it can be given by a congenital deformity or pericholecystic adhesions.

(2) Rigidity of the lesser curvature—compression of the bulb in this stage shows that the duodenal rugæ run toward a point on the lesser curvature where the ulcer is located.

(3) Formation of an incisura on the non-sclerosed wall. Some think that the notch is due to spasm, some to scarring.

(4) Formation of pouches. Following the deepening of the incisura there develop two

pouches on the opposite side of the ulcer. In the ulcer of the middle part of the wall, the two pouches have the same size and the bulb appears as cut in two. In the basal juxtapyloric ulcer and in the distal parietal ulcer there is only one chamber. The bulb takes the appearance of a torch in the first, of a funnel in the second. In this second stage the niche may persist as expression of the ulcer or of the scar.

Third Stage.—The sclerosis has gone beyond the territory of the ulcer and will change that part of the bulb into a narrow rigid canal. On the other hand, the pressure of the food tends to enlarge the chambers, which assume the appearance of pseudo-diverticula. In this third stage the author distinguishes six varieties of bulb:

(1) A rigid canal with diverticula (from the basal juxtapyloric ulcer).

(2) A rigid canal with only one basal diverticulum (from the basal parapyloric ulcer, the diverticulum being opposite the side of the ulcer).

(3) A rigid canal with two diverticula at the base, and symmetric, one on the right and one on the left (of the parietal ulcer in the middle portion).

(4) A rigid canal with two diverticula on the same side (from the parietal lateral ulcer of the middle portion).

(5) A very short rigid canal, wider towards the base (from the parietal distal ulcer).

(6) A rigid canal with multiple diverticula, symmetric or not.

Steps in the transition between the first and second stages exist; the most typical is the one which gives the appearance of a Mexican hat (*sombrero*)—the top is the niche and the wings are the basal chambers.

From the examination of the different forms of transition, one could say that the spastic incisura gradually blends into the permanent retraction of one of the walls. This explains why the deformity of the second stage cannot always be found by the surgeon.

The author believes that the direct signs of duodenal ulcer develop in definite sequence in keeping with the stage of the ulcer. He pro-

poses the following classification of the radiologic signs:

First Stage.—Initial ulcer with or without early sclerosis of the wall: (1) Niche of Haudek; (2) nail-head niche, and (3) star-like niche.

Second Stage.—Ulcer with definite areas of sclerosis: (1) Rigidity of the wall; (2) eccentricity of the bulb; (3) incisura, and (4) chambers.

Third Stage.—Results of sclerosis: Rigid canal with or without diverticula.

The signs are constant in the first and third stages, but are variable in the second stage when the niche has disappeared and the deformities are not yet firmly established.

These variable X-ray images are the result of the rapid passage of the opaque meal through the chambers of the bulb, and are secondary to the gastric hypermobility which is almost always present in this second stage. Often in the second stage one observes, at the beginning of the examination, a microbulb with a rapidly changing shape, due to the hypertonus and hyperkinesis of the bulb. After a while, however, the bulb increases in size and is completely filled, due to the hypotonus and hypokinesis which follow the previous state. Therefore, when a microbulb or one which changes shape very rapidly is observed, and there is doubt of this being the manifestation of an ulcer in the second stage, or a reflex spastic syndrome from diseased appendix or gall bladder, one must wait or give antispastic drugs until a completely filled bulb can be shown. This so-called spastic-ulcerative syndrome is an expression of the second stage of the ulcer; but without other co-existing signs is not of diagnostic value.

The author warns against the pseudo-bulb in which neighboring segments of the deformed bulb may take the appearance of a normal one, and cause the lesion to be overlooked.

E. T. LEDDY, M.D.

V. WITTING, M.D.

ULCERS (PERFORATING)

Closed Perforating Ulcer Manifesting Itself by Subhepatic Gas Bubble. Folke

Knutsson. *Acta Radiol.*, 1931, XII, Fasc. 2, pp. 157-163.

Free gas may be demonstrated under the diaphragm in over one-half of all cases of perforating, duodenal, or gastric ulcer. In a small percentage of additional cases a collection of gas occurs under the liver, while none is demonstrable above. Such a collection must be distinguished from normal meteoric gas in the digestive tract. This can be accomplished (1) when no other gas shadows are seen in the right hypochondrium or (2) when there is enough gas in the adjacent bowel to definitely establish it as outside the digestive tract. Two cases are described and the radiographs reproduced in which this sign is present. In one, the gas shadow was projected over the gall bladder in such a manner as to lead to the mistaken diagnosis of cholesterol stone.

M. J. GEYMAN, M.D.

ULTRA-VIOLET LIGHT

Ultra-violet Point Radiation in Production of Developmental Abnormalities in the Chick Embryo. Marie A. Hinrichs. *Proc. Soc. Exper. Biol. and Med.*, June, 1931, XXVIII, 1059, 1060.

The author exposed various regions of developing chick embryos to ultra-violet point radiation, the type of effect obtained depending on the dosage and the age of the embryo.

The results obtained when the developing eye was irradiated were as follows: (1) Inhibition of the rate of development as compared with the unirradiated eye; (2) killing of lens tissue; (3) stimulation of the rate of pigment formation in the optic cup. Short exposures of the fore-brain of a 2-day embryo produced lateral overgrowth on the exposed side. No such effect was obtained in the hind-brain. Longer exposures produced a coagulation of brain tissue.

Moderate exposures of the heart produced a slowing of the rate of beat and a loss of contractility of the exposed region on subsequent incubation. A 45-second exposure of the base of the aortic arches resulted in atrophy of the

exposed portions of the arches and of the portions of the body supplied by them. On the unirradiated side, the arches and the vessels were distended and larger than normal.

The developing tail and limb buds were relatively non-susceptible to moderate doses, but a 90-second exposure produced a coagulation of tissue in the hind limb of a 2-day chick.

J. N. ANÉ, M.D.

Influence of Ultra-violet Rays on the Vegetative Nervous System and Hypothesis on the Mechanism of Their General Action. Gastone Torelli. *Radiol. Medica*, October, 1930, XVII, 1156-1179.

Experiments performed on forty subjects have shown that the human body responds to ultra-violet rays by an increase in tone of the predominant neurovegetative system. In vagotonic subjects, this increase lasts from thirty to forty-five minutes, while sympathicotonic subjects present also a second phase characterized by an increase in vagotony.

These observations led the author to formulate the theory that ultra-violet rays, by penetrating as far as the surface of the derma, injure some of the cells by photo-electric action. The absorption of the products of disintegration and altered cellular metabolism into the blood stream would be influenced by a vagotonic reflection, caused by direct stimulation of the last ramifications of the sensitive nerves reached by ultra-violet radiation. This would result in a mild proteinic shock.

L. MARINELLI.

Ultra-violet Point Radiation in the Production of Arrhythmias in the Heart of the Chick Embryo. Marie A. Hinrichs and George Warrick. *Proc. Soc. Exper. Biol. and Med.*, June, 1931, XXVIII, 1057, 1058.

The hearts of twenty-six chick embryos were exposed to ultra-violet point radiation by the authors, who observed that in every case it was possible to modify the rate of beat or its rhythm, depending on the dosage used and

on the location of the point of the quartz rod on the heart. Tachycardia and bradycardia were observed in eleven cases, arrhythmias were produced in ten hearts, and the direction of the beat was completely reversed in five cases.

J. N. ANÉ, M.D.

NOT OTHERWISE CLASSIFIED

The Value of Fluoroscopy. Claude Moore. *Virginia Med. Monthly*, December, 1930, LVII, 576.

A comparison between European technic, which is 90 per cent fluoroscopy, and American technic, where fluoroscopy is becoming less and less popular, is made. It is the author's belief that American roentgenologists do not recognize the value of careful and routine fluoroscopy, the diagnostic possibilities of which are almost as unlimited as the diagnosis by means of films. Fluoroscopy reaches its greatest usefulness in gastro-intestinal disease, in which the opaque meal should be watched through the entire tract, though in many other conditions its value is apparently not recognized, or ignored.

W. W. WATKINS, M.D.

Ions of the Air as a Biologic and Therapeutic Factor. Carlos Heuser. *Semana Méd.*, Dec. 18, 1930, XXXVII, 1933, 1934.

This article is more or less based on the work of Dessauer, Happel, and Strassburger, who experimented for ten years on the ions of the air. They concluded that there were other factors, outside of climate, humidity, atmospheric pressure, etc., which acted on the functions of animals and plants, the most important of which were the ions in the air. They stated that all the elements composing the air were formed by ions which carried an electric charge.

Happel has proved in his experiments that the action of negative and positive ions is different, the former causing a feeling of malaise, the latter, stimulation. Furthermore,

he states that in rheumatic persons negative ions produce an improvement and sometimes a cure. Strassburger has been able to produce a decrease in blood pressure in hypertension cases. The author concludes that time will determine the adaptability of this method of treatment which at present is not well accepted.

N. G. GONZALEZ, M.D.

Notes on the Technic of X-ray Control in the Operating Room. Emanuel W. Benjamin. *Jour. Urology*, February, 1931, XXV, 165.

In from 25 to 50 per cent of the cases checked by the X-ray control film was there incomplete removal of renal calculi. These figures represent incomplete removal by skilled, competent surgeons. Both fragments and stones, measuring 1.5 cm. in diameter, had been overlooked. Particularly does this error occur in cases of multiple or dendritic calculi.

The present method of roentgen control is not infallible, yet is of a distinct advantage. Interpretation and differentiation play a major rôle. Blood clots, coagulated tissue fluids, and overlapping detached soft tissues may prove troublesome. The greatest single factor in the failure of this method is the incomplete mobilization of the kidney, so that the film does not completely cover the organ.

In 1929, Jaches designed and constructed a special small cassette measuring $3\frac{3}{4} \times 4\frac{3}{4}$ inches, with an aluminum cover, containing a double intensifying screen. The exposure time is reduced to one-tenth of what it was with the use of ordinary films. Clear, sharp pictures are obtained. The cassette is firm and does not buckle, and is easily and readily re-loaded. The films are read while wet before an illuminating box. The X-ray exposure is made in front of the patient, and the time is about half a second or less, at a distance of from 12 to 19 inches. Guide needles are inserted into the exposed organ by the surgeon. The loaded cassette is then dropped into a sterile rubber bag, the inside of which has been first carefully wiped dry, and the cassette is then tucked in behind the kidney,

great care being taken to cover that part of the kidney under suspicion. Either side of the cassette may be used against the kidney. The surgeon directly behind the patient aids the radiologist in guiding the X-ray beam. This procedure eliminates possible contamination of the operative field.

DAVIS H. PARDOLL, M.D.

Calcified Cysticerci in the Human Body. Josef Tóth. *Röntgenpraxis*, March 1, 1931, III, 229.

Calcified cysticerci in roentgenograms have been reported in a few instances. The picture is so characteristic that the diagnosis is easy. One finds multiple, spindle-like areas of calcification in muscles and subcutaneous tissue, the length of which is from 5 to 9 millimeters. Most cases are diagnosed only accidentally, as the patient has no clinical symptoms.

H. W. HEFKE, M.D.

The Value of X-ray Diagnosis in Medico-legal Cases. A. Howard Pirie. *Brit. Med. Jour.*, Nov. 1, 1930, II, 722-724.

It requires an expert not only to make the roentgenogram, but also one to interpret it. It is important to have a thorough knowledge of the formation of callus. Certain bones, such as the tibia, femur, ulna, and radius, form much callus, while the bones of the skull usually show no callus after fracture.

Examples are cited of the rare epiphysis at the proximal end of the second metacarpal bone, and of the epiphysis which occurs at the outer end of the acromion, both of which may be mistaken for fracture. They are, however, bilateral.

The importance of knowing the rare bones of the foot and wrist in order to be able to differentiate them from fractured pieces is stressed. Such bones are the os trigonum, the os peroneum, the extranavicular, the tibiale externum and others.

In the perfect examination for fractured ribs, it is necessary to have three sets of

stereoscopies—one anteroposterior, one at half left, and one at half right position.

The fact that the patella may develop in several parts, simulating fracture, must be recognized—the normal anatomy and also the normal variations must be known.

The technic for routine examination of the skull for fracture is given as stereoscopic left, stereoscopic right, anteroposterior, post-anterior—six views in all. Fractures of the base of the skull are rarely seen by X-ray examination.

WALLACE D. MACKENZIE, M.D.

Phleboliths in the Spleen. Th. Bársony and O. Schütz. *Röntgenpraxis*, Jan. 15, 1931, III, 68.

Multiple small and round shadows of calcifications have been described fairly often in the spleen. Bársony considered them to be phleboliths; other authors, however, have expressed their doubt about this explanation and called them calcified miliary tubercles (Courtin, Duken, and Assmann). To clear this doubt, the authors examined 180 spleens roentgenologically from autopsy material and found calcium shadows in seven cases. In the spleens examined from patients under fifty years of age, no calcification could be found; of the seven positive cases, six belonged to the age group of sixty to seventy-five. The calcified nodes were examined microscopically and found to be phleboliths. The miliary calcification of the spleen, as found during the examination of patients, corresponds to the picture described above, and can best be explained by the occurrence of phleboliths.

H. W. HEFKE, M.D.

Susceptibility to Cancer. William J. Mayo. *Ann. Surg.*, January, 1931, XCIII, 16.

According to the author, investigation of the various theories of the causation of cancer shows that the one provocative agent which remains unchallenged is chronic irritation. He reviews briefly the illustrations commonly used to prove this point. He states

that Wilson, MacCarty, and Broders have enlightened us greatly with regard to histologic character of the cell in relation to malignancy. It is probable that the more severe forms of cancer and the development of cancer in certain tissues is due to increased susceptibility. Perhaps the development of cancer, as well as its degree of malignancy, is attributable to the diminished activity of immunizing processes rather than to the nature of the activating agent.

F. B. MANDEVILLE, M.D.

A Quantitative X-ray Analysis of the Structure of Potassium Dihydrogen Phosphate. J. West. *Ztschr. f. Krist.*, 1930, LXXIV, 306 (in English).

A quantitative study of KH_2PO_4 , based on ionization spectrometer measurements and powder photographs, yielded experimental atom F curves for K, P, and O. Parameters were determined directly by double Fourier analysis. The structure deduced agrees with that of Hendricks (*Chem. Abs.*, XXI, 3777) except that the PO_4 group is found to be tetrahedral and the K atoms are equidistant from the surrounding O atoms. Probable positions for the H atoms are suggested. A method of determining the extinction coefficient of single crystals of high symmetry is described.

CHEMICAL ABSTRACTS.

Electrology: The Rays of Death and the Rays of Peace. Carlos Heuser. *Semana Méd.*, May 14, 1931, XXXVII, 1334-1336.

The writer is looking forward to the future, basing his statements on the discoveries up to the present time. He believes that the rays of death will soon become a reality, and to prove his theory he presents some of his experiments. He has been working with short waves—from 8 to 10 meters—on animals, such as rats and rabbits, putting them at about 20 millimeters distance between the two poles, and finds that they die from rise in temperature. If the head of the animal is within the action of the rays, death occurs instantly. Men working on this type of experiment often

develop intense headaches, vomiting, insomnia, nervousness, and generalized pain. In women, it inhibits menstruation and produces endocrine disturbances. Dr. Schlihaugen, of Jena, with whom the author has worked, believes that different wave lengths are applicable to different diseases; for instance, that of 16 meters for cancer cells, that of 8 meters for Koch's bacillus, that of 20 meters for general paralysis, and reports splendid results. He attributes this action to the following: (1) Rise in temperature, and (2) colloidal action and ionic movements in the cells. If such rays act in that manner, they can be applied in such a way that they can kill.

By the rays of peace, he means the immobilization of an army by means of distant rays. This is accomplished by means of aeroplanes causing explosion through short waves, rendering the men unconscious and causing severe headaches among them. The action and laws of cosmic rays are not known yet, but soon will be, this writer claims.

N. G. GONZALEZ, M.D.

A Treatment Lamp for Light Therapy: Kandem Arc Light Sun. W. Mathiesen. *Strahlentherapie*, 1930, XXXVIII, 361.

A new type of carbon arc light is described operating at from 110 to 120 volts between the carbons which are burning in a metal cylinder. Data on current characteristics, spectral emission, and on the erythema effect are also given.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Examination of the Male Gonorrheal Urethra. Z. J. Rotstein and Z. V. Chaskina. *Röntgenpraxis*, Oct. 1, 1930, II, 885.

Roentgenography of the male urethra may be of considerable help in gonorrheal diseases or their sequels. The technic is simple. After emptying the bladder completely the patient lies on his back, slightly rotated towards the left. The right leg must be flexed and ab-

ducted. A 25 per cent sterile solution of sodium bromide is injected in the stretched urethra, and a roentgenogram taken during the injection. Twenty-two patients were thus examined. While the roentgen method is not necessary in all such cases, it helps to visualize the lesion and its extent, as well as the progress and result of treatment.

H. W. HEFKE, M.D.

Methods of Scientific High Frequency Treatment. H. Hübner. *Strahlentherapie*, 1930, XXXVIII, 785.

The author speaks in this article in defense of high frequency therapy which has been very much discredited by its use in quackery. He hopes that an objective and scientific study of the subject will lead to a rehabilitation of high frequency therapy in medicine.

ERNST A. POHLE, M.D., Ph.D.

Effective Fighting of Film Fires. A. Giebmanns. *Strahlentherapie*, 1930, XXXVIII, 196.

The author describes briefly a film filing cabinet in which a sprinkler system has been incorporated.

ERNST A. POHLE, M.D., Ph.D.

The Effect of Liver on Kopro- and Uroporphyrin. H. Schreus and C. Carrie. *Strahlentherapie*, 1931, XL, 340.

Urine of a patient suffering from porphyria was concentrated and ground liver was added to a certain amount of it. This mixture was prepared for spectroscopic examination. The method is described in detail. It appears that the property of normal liver to destroy koproporphyrin is limited and not very pronounced. The decomposition by a certain amount of liver is proportional to the time during which it is effective. There is a definite difference between the effect upon koproporphyrin and uroporphyrin. The destructive principle does not tolerate boiling. It is still effective at a temperature of 50 or 60°

centigrade. Liver extracts do not show any effect, while liver which has been placed in the digestive fluids of man still destroys porphyria in the urine.

ERNST A. POHLE, M.D., Ph.D.

The Radiation Department of the Women's Clinic at the University of Munich. Friedrich Voltz. *Strahlentherapie*, 1930, XXXVII, 199.

The author discusses in detail the organization of the Radiation Therapy Department in the Döderlein Clinic at the University of Munich. The article is well illustrated and gives the reader a good idea of the excellent facilities available there for the treatment of malignant diseases.

ERNST A. POHLE, M.D., Ph.D.

Roentgen Cataract: Its Significance and Prevention. Max Cremer. *Strahlentherapie*, 1930, XXXVI, 732.

Since cataract has developed in patients following exposure to X-rays or radium in the region of the eye, the author has constructed a protective device of gold with a thin glass cover. It is shaped so that it can rest on the sclera without touching the cornea. The device was used in twenty-nine cases in which careful examination of the cornea by a cornea microscope did not reveal any erosions. A thickness of 1.3 mm. of gold corresponds to a lead protection of 2 centimeters.

ERNST A. POHLE, M.D., Ph.D.

Neurotrophic Disturbances of the Hand Associated with a Bite of a Cat or Colles' Fracture. Henry Turner. *Jour. Bone and Joint Surg.*, January, 1931, XIII, 161.

It is well known that occasionally Colles' fracture is followed by persistent pain, wasting and contracture of the soft parts, and marked decrease in the density of the bones of the forearm.

The author believes that when these unfavorable conditions occur they are the result of injury of the interosseous nerve. He de-

scribes three patients suffering from cat bites of the wrist. In two, the dorsal interosseous nerve seemed to be injured, and disability and marked bone rarefaction occurred similar to those seen in the type of Colles' fracture referred to above. In one, the nerve appeared to have escaped injury and in this case recovery was prompt and uneventful.

PAUL C. HODGES, M.D.

What should the Practical Physician Know Concerning the Physics and the Biology of Rays? Friedrich Voltz. *Münch. med. Wchnschr.*, Jan. 2, 1931, LXXXVIII, 14-17; Jan. 9, 1931, LXXXVIII, 61-64.

In setting down what he thinks the practical physician should know concerning the physical and biological characteristics of rays, the author gives a general discussion on the nature of rays, their origin—(a) natural and (b) artificial—and their effects. Specific phases of the subject, such as the importance of rays in practical medicine, will be discussed in later articles of this series, he adds.

The Radiometric Micro-analysis. Rudolf Ehrenberg. *Handbuch d. biologisch. Arbeitsmethoden*, 1930, XV, 1703.

The method which is described in this treatise aims to use the highly sensitive measurements of radio-activity for a micro-analysis of biologically important substances. Compared with other methods of micro-analysis, this one is rather simple, dependable, and void of subjective moments. If radio-active indicators (Thorium B, Thorium C, Radium D, and Radium E) are added to a salt of the element in question, which must be its isotope, a certain equilibrium between the element and its isotope takes place, which remains the same after any chemical changes. To the substance in question, the radio-active indicator is added. Precipitation must take place because the principle of the method is the distribution of the radio-active substance in the precipitate and the solution. The radio-activity can be measured by an electroscope or

electrometers. The special analytical methods for calcium, iron, potassium, sodium, sulphates, phosphates, carbonates, etc., are described in detail.

H. W. HEFKE, M.D.

The Dispersion of Light in Organic Bodies. J. Plotnikow. *Strahlentherapie*, 1931, XXXIX, 469.

This is a brief discussion of the dispersion of light in organic compounds and an attempt to apply the conclusions on the design of bathing suits. The principle is to permit a thorough irradiation of the entire body.

ERNST A. POHLE, M.D., Ph.D.

The Effects of X-rays on the Bone Marrow. L. Siciliano and C. Banci-Buonamici. *Archivio di Radiologia*, November-December, 1930, VI, 1108.

The authors studied the effects of X-rays on the bone marrow, both by a review of the literature and by studies carried out on animals. They applied doses ranging from a fraction of one to 18 H at varying intervals to different fields, and examined the bone marrow in smears and histologic preparations. Changes were found in that part of the bone marrow which was irradiated, and marked distant effects were noted in marrow that had been protected against radiation. The authors believe that an indirect effect is largely responsible for the changes noted in the treatment of blood diseases.

E. T. LEDDY, M.D.

The Value of X-ray Studies to the Patient. Editorial. *The Modern Hospital*, June, 1931, XXXVI, 92.

This is a discussion of the value of the X-ray in diagnosis. Not only must the radiologist be able to obtain clear films, but he must have the ability to interpret them and to attach to them a clinical significance. The

physician on the case frequently relies to such a great extent upon the X-ray report in making his diagnosis that the patient's life may depend upon the outcome.

There is a contention that much of mysticism and of the dramatic is attached to the X-ray specialist, and that, due to this, the public has been willing to consider an exorbitant fee as a necessity without questioning the reason for it. Every private X-ray laboratory should endeavor to render to the public the best possible service at the least possible cost.

Recent Observations Concerning X-ray Cataract in Man. Rohrschneider. *Ztschr. f. Augenheilk.*, December, 1930, LXXIII, 97.

X-ray cataract is described as a particular form of exogenic cataract. Comparison is made between it and other cataracts, especially glass-blower's cataract.

A More Accurate and More Extended Cosmic-ray Ionization-depth Curve, and the Present Evidence for Atom-building. Robert A. Millikan and G. Harvey Cameron. *Physical Rev.*, Feb. 1, 1931, XXXVII, 235.

The authors continued their studies on the relation between cosmic-ray ionization and depth in equivalent meters of water, in order (1) to give further proof of the theory that the cosmic rays have their origin in the formation of helium, oxygen, and silicon out of hydrogen; and (2) to confirm and extend the ionization-depth curve, as formerly reported, at both its upper and lower ends.

From their results, the authors present evidence that the absorption curve shows an unmistakable banded structure, that the strongest and most absorbable band of the cosmic radiation comes from the formation of helium, and that three more penetrating bands are due to the formation of the other abundant elements of the oxygen, silicon, and iron groups. There also seems to exist sufficient evidence that the cosmic rays enter the earth's atmosphere as photons. The theory of the four observed bands being due to the forma-

tion of these elements is consistent with the observed cosmic-ray curve, which was considerably extended and made more accurate. The ionization values were obtained and confirmed by measurements with a highly sensitive electrometer of special construction. They were made on top of Pike's Peak and at various depths of two lakes (down to 262.5 feet). The absorption coefficients obtained in this manner vary from 0.35 per meter of water at the top of Pike's Peak, to 0.028 at the lowest depth of the lake.

OTTO GLASSER, Ph.D.

Sirocco Studies in Naples. Otto Kestner. *Strahlentherapie*, 1931, XXXIX, 391.

The peculiar reactions of man to the sirocco induced the author to study its physiology. He found that the sky radiation during the presence of the sirocco is very great. The

blood pressure in the persons examined was definitely decreased and the air contained traces of nitric acid.

ERNST A. POHLE, M.D., Ph.D.

Radiological Examination as a Means of Diagnosis of Death. Mario Maino. *La Radiologia Medica*, May, 1930, XVII, 544.

Of the different radiological means by which death may be diagnosed, the study of circulatory movements is certainly the most reliable. The author reviews the literature on the subject and criticizes the different methods that have been used. He advises the injection of 1 c.c. of a 5 per cent solution of potassium iodide in the cephalic vein at the elbow. The persistency of the image of the vein after a reasonable time would unequivocally confirm a diagnosis of death.

L. MARINELLI.

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